THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXVI. No. 1679.] LONDON, JULY 16, 1895. [47TH YEAR. PRICE 6d.

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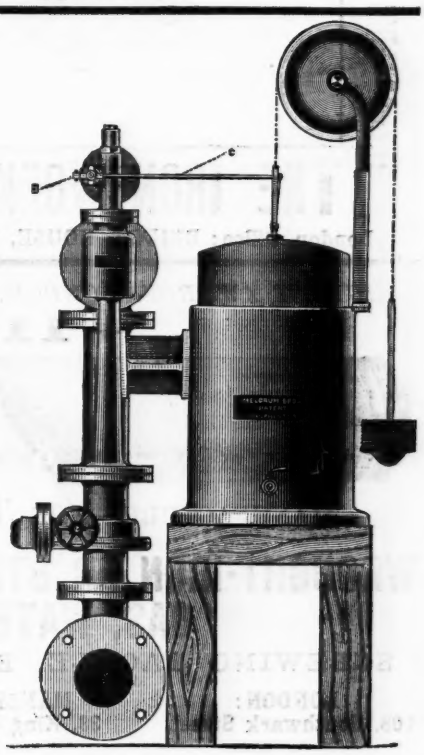

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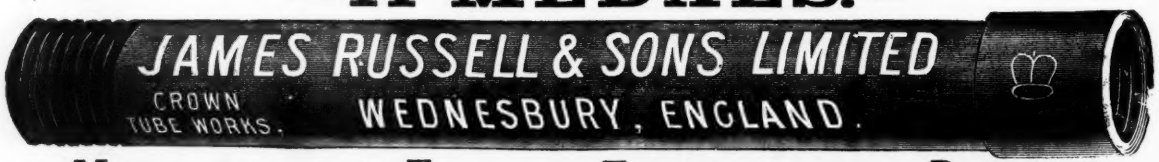

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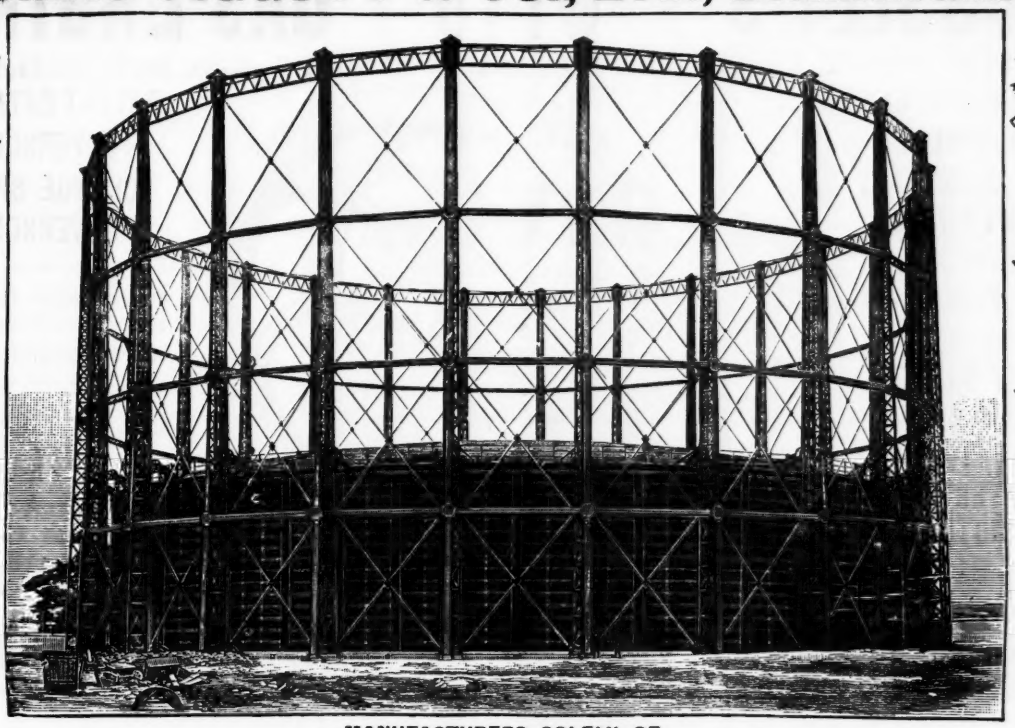

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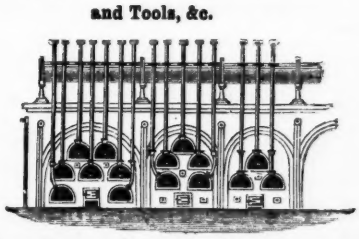

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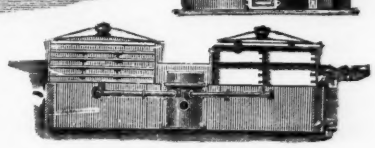

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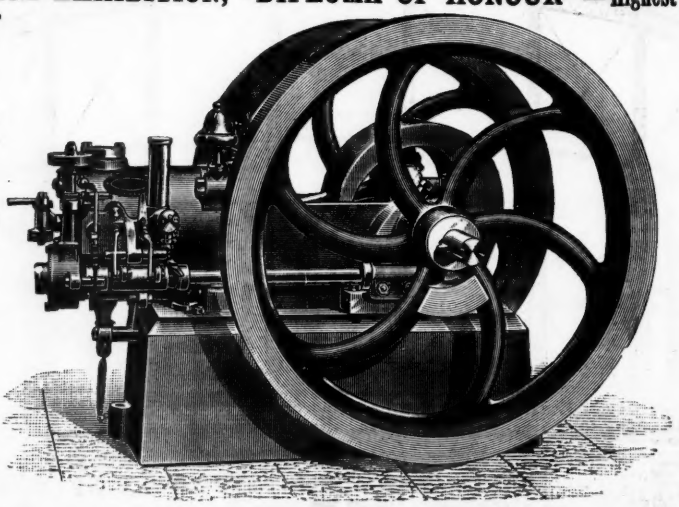

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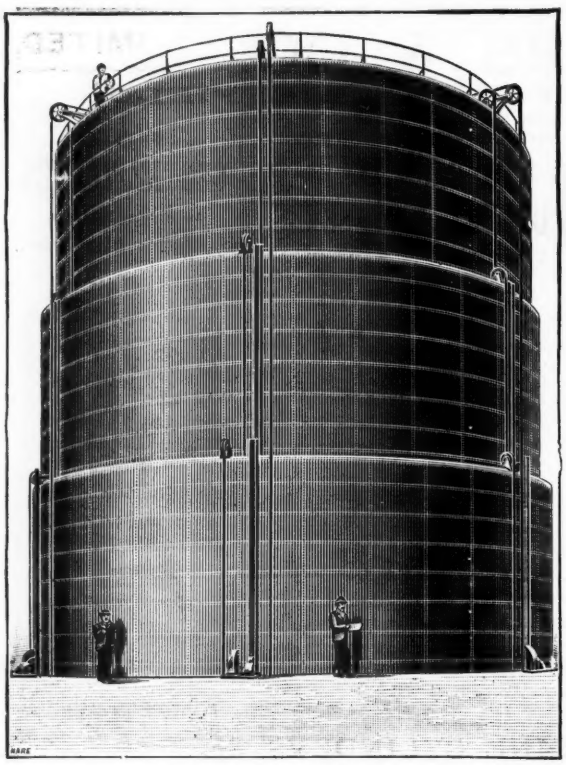

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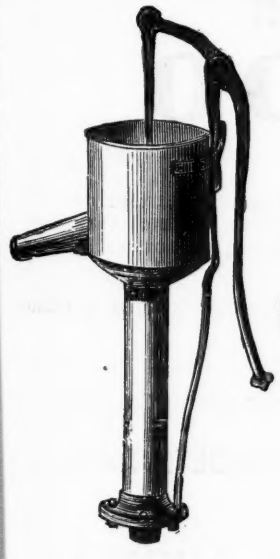

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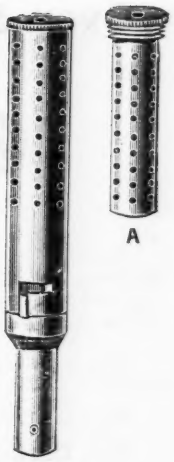

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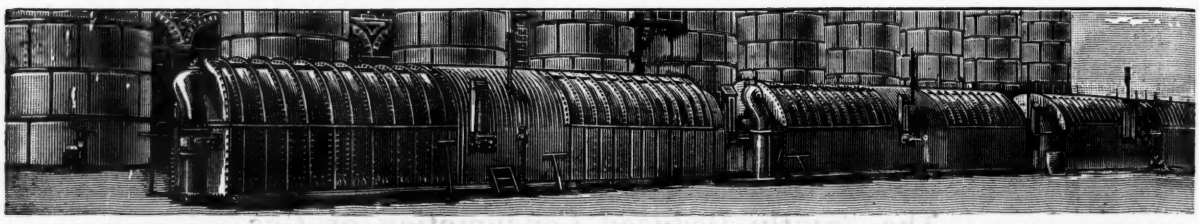

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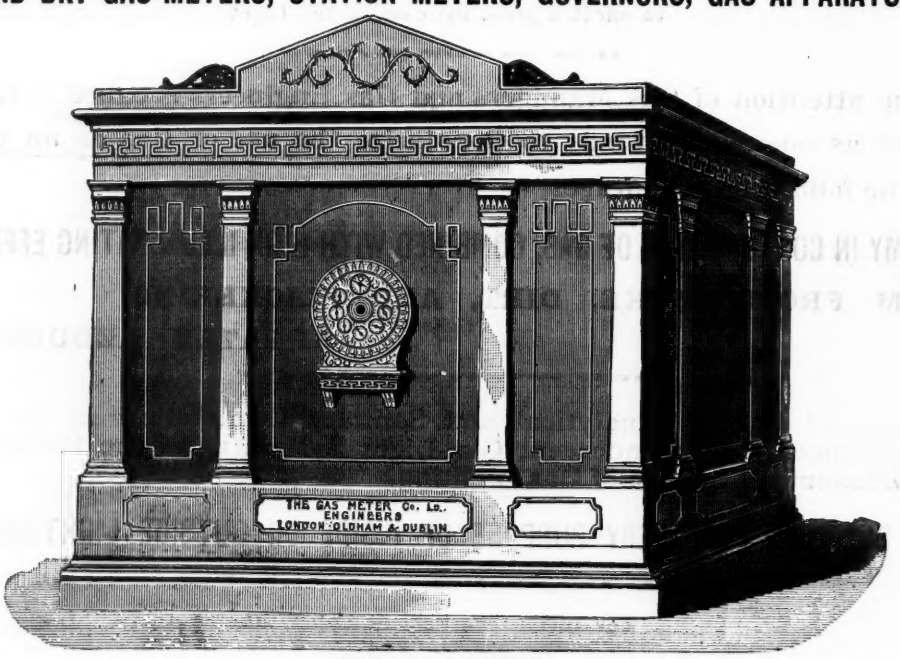

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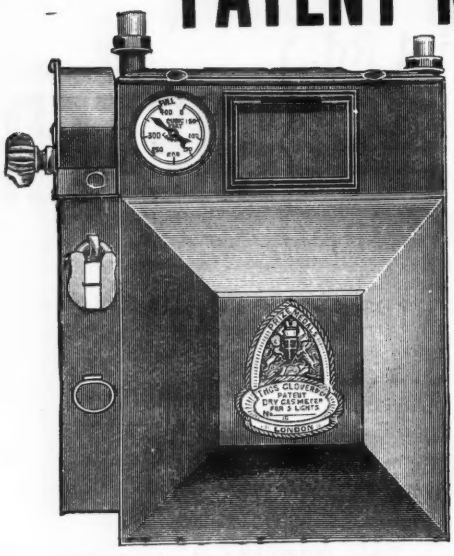

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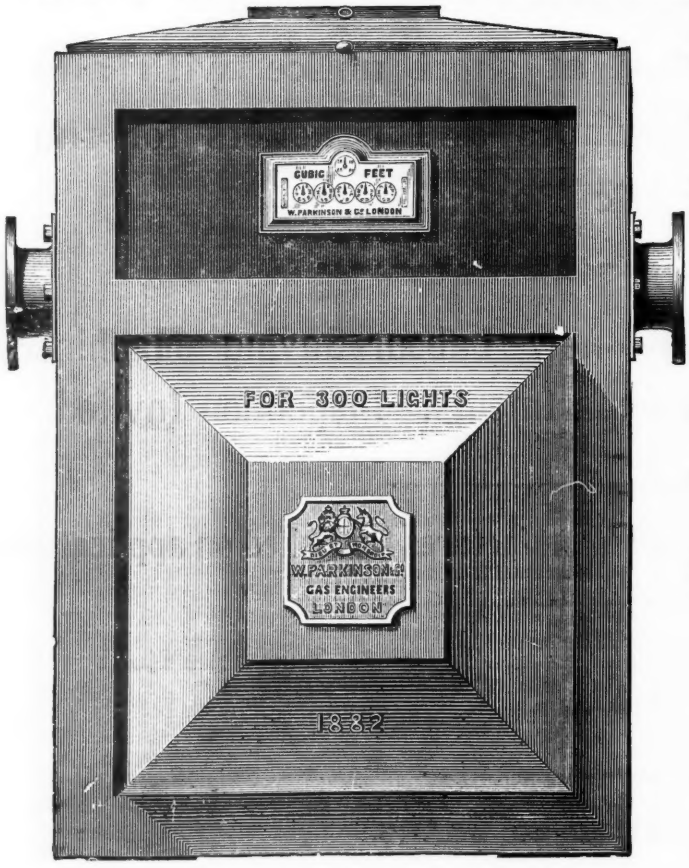

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[See also Advt., p. 160.

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TO CORRESPONDENTS.

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EDITORIAL NOTES.

Mr. Carr against the "Time-Spirit."

MR. W. CARR writes to say that everybody, the JOURNAL included, misunderstood that remarkable speech of his at the meeting of The Gas Institute we reported last week, in which he took strong exception to the "inhumanity" of the idea, fathered upon Mr. Stelfox and Mr. William King, that it is always desirable to reduce the number of labourers in gas-works. We are always most pleased to hear from any reader of the JOURNAL whose individuality is so well marked as Mr. Carr's; and we are not at all offended at his calling us obtuse on matters affecting "the larger "questions of humanity." It is quite true, as he observes, that specialist writers are liable to become narrow. But, so far as the JOURNAL and the labour question are concerned, conscience absolves us from this impeachment. Remembering, indeed, how roundly we have been abused for treating the subject of workmen-directors as even debateable—remembering how many articles we have published dealing with this and other developments of the question of the day with a detachment from the purely technical standpoint for which we have frequently felt disposed to apologize—this accusation of Mr. Carr's may be allowed to pass. It appears that what he is protesting against is the principle which he detects underlying Mr. King's observation concerning the desirability of reducing the number of gas-works hands quite independently of the economical consideration. Where labour-saving means reducing the cost of production, by all means save it, says Mr. Carr; but where the inducement to eliminate or reduce hand labour is only that of saving managerial worry, then, he holds, it is a temptation that should be resisted. "I protest," he says in his letter, "against it being taken "as an axiom that it is better in every respect to employ "20 men instead of 200, apart from economical considera-"tions. I say the reverse is the case—that the man who "can feed or provide a good living for 200 men is ten times "the benefactor of the man who only provides for 20. To "speak of throwing 180 men out of employment for no "other consideration than that it shall save you a little "trouble, is inhuman." This is Mr. Carr's real position, as defined by himself; and we are sorry if any comment we have offered upon his speech was misdirected, or tended to misrepresent him before the technical world. Whatever men talk about, it is a prime necessity that they should understand what are the exact points at issue.

Now, having had this issue made clear for us by Mr. Carr himself, we regret to be compelled to remark that the matter is not thereby seriously advanced. Before one man accuses another of partiality for inhuman practices, it is desirable for the accuser to make sure that the accused cannot object to the terms of the indictment, whether he is to be found guilty or not guilty by the opinion of his peers. In the present case, it seems to us that the subjects of Mr. Carr's attack might well object, if they chose to do so, to the language in which it is couched. When one calls a man a thief, there is at least no possible misunderstanding of what is meant, and the issue of his guilt or innocence turns wholly upon the solution of the question of whether he has or has not stolen something. It is very different with the class of ethical considerations now invoked by Mr. Carr; for it is impossible even to specify the nature and extent of the evidence that would have to be heard on both sides before it could be determined whether his ascription of such a term as inhumanity to an assumed principle of action in the world of industry is justifiable or not.

To go no farther into this matter, it may be observed that what Mr. Carr calls "saving yourself a little trouble" —his alleged reason for some men's preference of machines to men—covers a very wide and varied order of considerations, from many of which what he elsewhere allows to be valid economical reasons cannot be excluded. Is it conceivable that a works' manager ever found himself in a position to decide, on grounds of purely personal convenience, whether he should employ 200 men without machinery, or 20 men with machinery, to effect a particular object? We think not. But until such a position is created, it is idle to argue as if the personal equation determined everything in connection with labour problems of the kind. And even then, when we have made the manager personally chargeable with the consequences of actions performed in his managerial capacity, how often would not

the term "saving himself trouble" be found to mean ultimately saving his employers' money, and protecting the interest of the public?

The displacement of workers by labour-saving machinery is a process which, however motived, has gone on ever since the dawn of intelligence upon the earth, and will continue to extend into more branches of industry as mechanical science improves. Mr. Carr would admit that machines are improved upon year by year and day by day. They are the productions of men who are themselves improvements upon their precursors in their chosen employment. It is consequently obvious that, if other men are to live at all, they must likewise improve themselves. They are doing so, on all hands. Whether or not gas managers personally desire to eliminate the labourer, say of the gas-stoking variety, is their own affair, and will soon be immaterial; for the race is becoming extinct. How many of the Board School population of to-day will care to be gas stokers when they are grown up? Everybody knows that it is difficult enough to catch a sufficiency of them to make the required number of blacksmiths, bricklayers, plumbers—tradesmen who can never be dispensed with, whatever the triumphs of the mechanician. Will the rest become coalies, cokeys, or stokers? Not a bit of it; but they may yet be converted into more efficient carbonizers than their fathers by giving them a machine-handle to manipulate, in place of the shovel and rake which they would not touch.

If Mr. Carr will look into this subject a little more deeply, refraining from gratifying the desire to use hard terms for labelling other persons withal, he will see that the competition between men and machines is really a contest of brute strength with intellect, and that the individual predilections of those who look on or employ either of these forces have not the smallest influence upon the course of the struggle or its result. These things are of the working of the Time-Spirit, which is uncontrollable by man, though it is his creation and collective presentment.

A Profitless Prophet.

THE paper by Mr. F. H. Medhurst on "Electricity Supply "from Town Gas," which appears in another column (with the discussion), brings to a close our report of the proceedings of the Incorporated Gas Institute last month in Edinburgh. The finish cannot be regarded as a brilliant crown to the technical work of the meeting; for the paper in question is a particularly feeble production. Mr. Medhurst is the first electrician who has addressed an audience of gas managers in this way; and it is a great pity that the novelty of the occasion was not reflected by the same quality of his matter. When giving our preliminary notice of the programme for Edinburgh, we remarked, in regard to this particular paper, that if there were any of the author's professional brethren in the city, it would be a satisfaction if they would attend the reading, and help to elucidate the subject. The aspiration was not gratified—the author was without support; and when the character of the paper became known, it was possible for those who heard it to appreciate the astuteness of those who stayed away. The failure of Mr. Medhurst to impress his audience favourably is to be regretted, as the opportunity provided by the good will of the Council of The Gas Institute for blending gas and electrical engineering in a really interesting and instructive conference, was thrown away. We trust that gas managers will always be ready and willing, at their meetings and otherwise, to extend a patient hearing to any outsider, be he electrician or anything else, who shall have something to say to them that is worth listening to; but when a reader of a paper comes before an assembly of technicians with a composition set in a key that would hardly harmonize with the tone of a small Mutual Improvement Society, and has to admit, before he gets very far, that he is "only prophesying," he commits a trespass upon the good nature of his company.

The paper began well by laying down the propositions that "the electric light has come to stay; and that in "every town, of even average importance, there is a fair "and increasing number of persons desirous of having "their business or private premises electrically illumi-"nated—even though the cost, in the great majority "of cases, be greater, light for light and time for time, of "the electric than the gas light." It was unnecessary to write a paper to support these unquestioned observations, which go no farther than has often been admitted in these columns. Electric lighting is one of the luxuries of the age; and it would be ridiculous for a gas engineer or for any other individual pretending to a reputation for sanity to deny the fact. The weakness of electricians and their partisans, which is so peculiarly irritating to gas engineers, is the trick they have of affecting to regard the gas industry as moribund from the instant of their appearing in the market with this luxury to sell, and gas engineers as unscientific, ignorant, stupid persons immeasurably beneath their own lofty attainment. If Mr. Medhurst had confined himself at Edinburgh to the strict technics of his subject, he would have had a very different reception. But no—he at once "mounts the high horse," and talks about the approaching extinction of the gas industry as certain to come to pass so soon as the trifling *desideratum* of a full and equal load on electricity generating plant throughout every hour of the twenty-four, shall once have been provided.

If a competent electrician will attend a meeting of gas managers, and say: "Come now, we are engaged in inde-"pendent industries which all experience shows to be "quite capable of co-existence in time and space. I "believe there are points of contact between these in-"dustries, where it is possible for one to help the other. "Let us discuss these points"—such a man, speaking in such a spirit, will be ever welcomed by such an audience. They will listen to him; consider what he has to say; and give him their own views and experiences fully and freely. The day is now past, however, for papers like this of Mr. Medhurst, which do not advance any cause, and which it is only a waste of time to criticize in detail.

More Dublin Gas Litigation.

ANOTHER legal tussle has just taken place between the Corporation of Dublin and the Alliance and Dublin Consumers' Gas Company, with the usual results that the Company come out on top, and the ratepayers are left to pay another little bill of costs. Whoever it is that inspires the Corporation with this insane rancour against, and predilection for fighting, the Gas Company, it would be cheap to the City to pension him or them off handsomely, and let the public lighting go on under rational, business-like supervision. This time it was a question of street-lamp meters; and the comment of the *Freeman's Journal* on the incident is that "the judgment of the Master of "the Rolls shows that the Committee proceeded in the "matter as if their sole desire was to invoke an action-at-"law under circumstances that would ensure their being "beaten." The Gas Committee had to do the metering of the public lamps; and they bought for this purpose 180 meters at a cost of £230. The Company objected that these meters were not fit and proper articles; and they required satisfactory ones to be substituted. Of course, the Corporation refused to do anything of the kind; and the Company availed themselves of their legal remedy. It was proved that the Committee were not misled as to the meters they selected. They were told that "they "might do," which, as the Master of the Rolls observed, meant "they might not do." Yet the Secretary of the Committee was instructed to write to the Company and state that the meters were the best that could be had for money. The Dublin newspaper comment upon this "extraordinary "statement" is that it "needs explanation." We know, unfortunately, as much about the whole state of Dublin gas affairs as any explanation likely to be forthcoming could tell us, and rather more. It is now a long time since the Corporation, in dealing with the Company, in the name of the citizens of Dublin, adopted a policy the only fruit of which is "costs on the higher scale." They have persisted in carrying out their policy with childish vindictiveness and a degree of misdirected ingenuity in making occasions for lawsuits which are alike amazing to people with sober minds. It is not necessary to be a partisan of the Company to see the folly of this ridiculous warfare. If there were anything to be gained by it for the citizens of Dublin, we should admit the existence of some excuse for the litigiousness manifested by the Corporation. There are people who would rather win something as the result of a lawsuit than come by it amicably; but in their litigation with the Gas Company, the Dublin Corporation are invariably the losers. Nor can it be pretended that their policy in this regard is popular; for the last Bill promoted by the Corporation, which was sweetened for the public taste by the insertion of confiscatory gas proposals, was

rejected by the ratepayers. This history may be commended to the study of those perfervid apostles of Municipalism who profess to believe that local authorities are always truly representative of the people, and that they can do no wrong. So far as their schemes of legislation and their gas litigation are concerned, the Corporation of Dublin are both unpopular and always in the wrong; yet nobody is able to suggest a way out of this sad perversion of the principle and powers of local self-government.

The Society of Comparative Legislation.

An article by Sir C. Ilbert in the current number of the *Nineteenth Century* explains in an interesting manner the aims of the newly-founded Society of Comparative Legislation. The Society appeals for support not merely to professional lawyers, but also to all those who are concerned in the manifold political and social problems which English-speaking peoples all over the world are endeavouring to solve; and it is an attempt to save labour and prevent mistakes by collecting all available information as to what the different Legislatures are doing, and how the laws which are enacted from time to time are found to work. It is unnecessary to argue for the usefulness of such an organization. The only marvel is, as Sir C. Ilbert observes, that such a society has not long been in existence. Readers of the Journal are naturally concerned in a very intimate manner with a large number and great variety of those subjects of legislation which bear relation, not, as the Roman historian would have it, to the degeneracy of each State, but to the variety and complexity of its needs. Then, again, there is a striking similarity between the subjects of legislation in different States. Everywhere various solutions are being attempted of similar problems. Sir C. Ilbert refers, for example, to the attempts which are being made by Australasian colonies, with more or less success, to enforce the eight-hour day. In most colonies also boards of conciliation or arbitration in labour disputes have been established, with or without compulsory powers for enforcing their decisions. The factory legislation of Australia is said to be in some respects in advance of our own. Yet it is a standing reproach to our newspapers that very little information respecting Colonial or American experiments of this kind finds mention in their reports of current events. The conductors of these vehicles of information and public opinion appear to entertain very peculiar notions of what their subscribers prefer to read about, and constantly occupy their columns with matter derived from Continental journalists, and dealing with the most ephemeral and unprofitable trash, to the exclusion of what is of sterling interest. The new Society will endeavour to fill the void, so far as records of legislation are concerned. "It will apply to jurisprudence the comparative method of "investigation, which has already proved so fruitful. It "will gather together, epitomize, and arrange materials "now scattered through many periodicals, or to be found "only in official documents, of which few libraries contain "copies; and it will endeavour by other means to promote "the study of comparative legislation. One of its chief "aims will be the collection of information as to the statute "law and the forms and methods of legislation in the British "Empire and the United States." Most of the work of collection and compilation will be done by Committees; and we venture to hope that one of the subjects to which attention will be directed as soon as possible will be the application of legislation to the regulation of the great supply industries, such as that of gas lighting. The relations of central and local governments to such industries are questions of law and of fact which have never yet been brought under one compendious review; and nothing but benefit can follow upon an attempt, which could very naturally and easily be made by Sir C. Ilbert's Society, to establish the principles by which these relations can best be regulated.

Mr. W. J. Sturges, the Secretary of the gas undertaking of the Smethwick District Council, has had his salary increased by £25 per annum.

Mr. John T. Sheard, F.C.S., has been appointed Chemist to the Sheffield United Gas Company, in succession to the late Mr. S. H. M. Davy, F.C.S.

The New Chairman of the Canterbury Gas and Water Company is Mr. Daniel Amos, J.P. He was elected to the post at the meeting of the Board on Monday of last week, in place of Mr. George Furley, whose resignation was recently announced in these columns.

WATER AND SANITARY AFFAIRS.

The kind of paralysis which has fallen on the Metropolitan Water Question leaves the way open for considerable freedom of conjecture as to the development which awaits this subject. Before any definite conclusions can be reached, it is necessary to forecast the result of the Parliamentary Election now in progress. Apart from all political considerations, we may infer that a change such as now seems to be impending will establish a Government disposed to deal with the water question in a very different manner from that pursued by a party having sympathy with County Council designs of the Progressive type. As for the plans which the Council may now be expected to adopt, the scheme embodied in their Transfer Bills must, as we signified last week, be essentially modified if any respect is to be paid to the views expressed by Mr. Plunket's Committee. But let the County Council concede what they may, the chance of the Bills getting through Parliament this year is so remote, that these measures may as well be looked upon as defunct. The entire water question, as it affects the Metropolis, seems destined to stand over till next year. In what shape it will then come before Parliament it is difficult to say, except that the County Council will doubtless renew their attack on the London Water Companies. What line the Corporation of the City will take, is a matter which ought not to be so settled as it is supposed to be. It would redound to the dignity and honour of the Corporation if they would shake themselves free from the County Council in respect to the water supply, and were to bring in a measure of their own. They could propose a Water Trust covering the entire area of supply; a proper system of representation being devised for the constitution of the new authority. Representatives from the outer areas would naturally form part of the organization; and a thoroughly harmonious plan could thus be perfected. The Corporation have little to fear now from the Unification scheme which the County Council prepared and the late Royal Commission adopted; and the formation of a Water Trust or a Water Board might be undertaken by the civic authorities with a very fair chance of success.

Still, as we have already signified, the London Water Companies have no desire to sell their property; and, if the popular voice could be distinctly heard, it is very probable that London would be found by no means anxious to effect a purchase. There remains the method advocated by Sir John Lubbock, providing for the further control of the Companies, in lieu of buying them out. Opinions may differ as to the precise shape this control should take; but that which immediately affects the consumer consists in a careful inspection of the water, and the completion of the constant supply. If further guarantees are wanted with regard to the purity of the water, these could be given. Yet an undertaking in which many millions of capital are invested must necessarily partake of a commercial character; and the control to be exercised over it by external authority could not be allowed a degree of power which would play havoc with the finances. If control is to take the shape of interference, the supply must forthwith change hands—the control being made to rest where the financial responsibility exists. But if there is to be a reasonable plan for vesting the water supply of London in one representative public body, it is very clear that we may not look for it as emanating from Spring Gardens. Either the Government must bring in a Bill for the purpose, or the Corporation must undertake the task. The County Council have made themselves impracticable on the subject. Their last resort will be to propose an entirely new supply. But such a project presupposes the buying-up of the supply that now exists; and to do this in accordance with the principles of equity and fair dealing, is something to which the County Council appear to be unequal.

The weekly publication which is specially devoted to the interests of the London County Council, remarks on the comparative absence of London topics from the addresses of the candidates for London constituencies. Mr. Costelloe, as might be expected, has something to say about the water question in his appeal to the electors of East St. Pancras. He refers to the Bills for "the transfer of "the Water Companies" to what he is pleased to call "the London public authority." Mr. Costelloe says that, in promoting these Bills, he has had to take "an important

"part;" but he looks upon the water question as "only "one amongst a multitude of domestic reforms," all of which are at present "blocked at every point by the "bitter and unreasoning opposition of the London Tory "members." But we cannot see how these members are to be held responsible for the backward state of the Transfer Bills. The County Council are mainly accountable for the slow progress made with these measures, especially the six which have been held back from the second reading stage. The "multitude" of other reforms is a significant phrase, which well accords with what we find in most of the addresses which advocate the acquisition of the water supply by the Council. Mr. W. C. Steadman, in addressing the electors of Hammersmith, declares himself particularly anxious for the municipalization not only of the water supply, but of "gas, tramways, omnibuses, markets, docks, and electric "lighting," the profits of which he estimates at £4,000,000 a year. This splendid revenue he desires to see swept into the treasury of the County Council, "to be devoted "to public purposes." Of course, in such a golden age, there would be no rates to pay, or at least there ought not to be. But we have hitherto found that the spending power of the Council is only limited by the available sources of income. Mr. Mark Beaufoy, at Kennington, has expressed a wish to see the powers of the County Council extended, so as to include "the control of the "water supply." Mr. E. A. Cornwall tells the Fulham electors that this control should be placed "in the "hands of the people." The County Council will doubtless say: "We are the people." But throughout the contention for municipalizing the water supply, we find clear indications that other interests are to be absorbed in like manner; and there seems no end to the programme.

Mr. Geoffrey Drage, whose name will be remembered by our readers in connection with the Labour Commission, the arduous secretarial duties of which he discharged with conspicuous ability, was last Saturday returned to Parliament for Derby. Mr. Drage polled 7076 votes; and his colleague (Mr. Alderman Bemrose), 7907 votes. Both of the new members are Unionists. The unseated members (Sir William Harcourt and Sir T. Roe) polled 6785 and 6475 votes.

Death of Mr. W. C. Humphrys.—This event occurred at Warton, near Carnforth Lane, on Wednesday last. Mr. Humphrys, who had attained the age of 86 years, retired from active business some time ago. A large portion of his life was devoted to the promotion of gas and water companies; and he held the appointment of Secretary to the Barnet District Gas and Water Company for several years. He was connected with the undertaking—which was in the hands of private individuals—during the early years of its existence, from the date of its commencement; and his experiences date back to the introduction of gas lighting in our smaller towns. He was a member of the British Association of Gas Managers. His two sons—Mr. Norton H. Humphrys, of Salisbury, and Mr. F. C. Humphrys, of Ilkeston—are well known to many of our readers.

Presentation to Mr. John Tindall.—Mr. John Tindall has just completed a quarter of a century's service as Manager of the Walsall Gas-Works; and on the evening of last Saturday week, the workmen, to the number of 150, assembled at the Pleck station in honour of the event, and to present Mr. Tindall with a token of the respect and affection in which he is held by the employees. In one of the buildings, an excellent dinner was served, after which the chair was taken by Mr. John Webster, the Works Foreman, who said he believed the whole of the workmen had contributed to make the testimonial a success. The Outdoor Superintendent (Mr. J. O'Farrell)—having spoken of the goodwill which existed between Mr. Tindall and his men, and acknowledged his consideration for them, and the principles of justice which had marked his control of the works—presented the address, which was beautifully ornamented, and which tendered to Mr. Tindall the congratulations of the workmen on his having completed so long a term of office, and requested that he would accept the address and the accompanying photographs of himself and Mrs. Tindall as a small recognition of their goodwill. Mr. Tindall, in responding for himself, his wife, and family, said he as captain of the works had been greatly blessed with a loyal crew. The good feeling which had existed, and of which that gathering gave proof, would always be remembered by him as long as he lived. Of course, there had been some little matters and difficulties to get over, of which the public had known nothing, such as the provision of sufficient gas in the depth of winter, and in seasons when long-continued fogs prevailed; but he was happy to say that he had never called upon his men to do their utmost without having a ready response. The Gas Department of the Walsall Corporation was like the town—it was rapidly going ahead. Other speeches followed; and the proceedings closed with songs and conviviality.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTY-SECOND ANNUAL GENERAL MEETING,

HELD AT THE

QUEEN STREET HALL, EDINBURGH, JUNE 11, 12, & 13, 1895.

ROBERT MITCHELL, Esq., President.

PAPERS AND DISCUSSIONS.

ELECTRICITY SUPPLY FROM TOWN GAS.

By F. H. MEDHURST, of London.

It is with great diffidence that I venture to submit for the consideration of this influential Institute a few important questions in connection with the supply of electricity from central generating stations for public and private purposes. It will probably be freely admitted by every member of this Society that the electric light has come to stay; and that in every town of even average importance there is a fair and increasing number of persons desirous of having their business or private premises electrically illuminated—even though the cost, in the great majority of cases, be greater, light for light and time for time, of the electric than the gas light.

It is no longer necessary to urge, in a paper like the present, the numerous and unique advantages of electric light, because they are now almost as freely recognized by gas engineers as by electricians. But if the proposition that electricity supply from central stations has been established on a thoroughly sound financial basis be not accepted without doubt or question, then I think that the fact that local authorities are everywhere establishing electricity supply works, and that in 1894 these works were in the proportion of 10 to 1 as compared with those started in the same year by companies, must carry conviction to the minds of the most sceptical; for we do not find local authorities in Great Britain recklessly investing public funds in undertakings that have not given unquestionable proof of their lucrative character.

Nevertheless there can be little or no doubt that the number of electricity supply works in existence, and in immediate contemplation, would be greater than is actually the case but for the strenuous opposition which the electric lighting industry has from the commencement sustained from almost all those interested in the maintenance and development of the gas industry. From time to time it has been attempted to pacify this opposition by reminding shareholders in gas companies and gas engineers and managers that actual experience has hitherto demonstrated that in towns where central electric lighting stations have been erected, the consumption of gas has actually increased instead of decreased. It has been plausibly and not altogether unreasonably asserted that the advent of a public and private supply of electric light has improved the general standard of lighting; and that those who have preferred to retain gas have been forced by sheer competition to add considerably to the numbers of jets in their shop windows and shops, in order not to be outdone by those in the same line of business who have adopted the new illuminant. Then, again, I think it must be admitted that heating and cooking by gas have received a great impetus since the advent of the electric light; and, generally speaking, the fact that the managers, directors, and engineers of gas undertakings have been "put on their mettle" owing to competition with what was formerly almost a monopoly, must in some measure account for the apparent paradox that in districts possessing a public and private supply of electricity the consumption of gas has continued to increase.

But to infer from this undoubted fact that the last word has been said with respect to the competition between gas and electricity would, I think, be highly injudicious. My own opinion is most emphatically that the effects heretofore observed, and that I have tried to explain, are merely transient in their nature; and I think that a very little calm consideration must show that to maintain that because hitherto the consumption of gas has not been seriously affected by the use of electricity, therefore it never will be prejudicially affected, is to display ignorance or disingenuousness. With respect to my contention that, in the

long run, an increased demand for electricity in a particular district must decrease the demand for gas in the same district, I will say at once that if electricity could only be used for lighting I should be of a contrary opinion, because so long as the demand for the electric current be satisfied by a use of the generating plant in the twenty-four hours equivalent to only an output of the plant for from three to five hours at full load, so long, I say, as electricity supply works continue to suffer from very small load-factors and from very imperfect means of storing electrical energy, will it be impossible to sell electricity for less than from 4½d. to 8d. per Board of Trade unit. And I do not think that gas companies have much to fear while these rates are a necessity. On the other hand, I believe there are abundant indications tending to show that these prices are certain to be shortly materially reduced Cooking by electricity has produced excellent results; at least one London theatre has been heated throughout by electric radiators; and electric motors are probably the cheapest, most efficient, and most convenient motors for small powers. In a word, I do not think it too much to say that electricity from town mains is capable of accomplishing everything that may be done by town gas, with the almost single exception, if I may be permitted to say so, that electricity will not contaminate the atmosphere we breathe.

Electrical engineers recognize that the cheapening of the electric current produced at central stations depends, in a very great measure, on the extent to which electricity comes to be used during the daytime, and generally during the time when the generating plant is not required for lighting purposes. I have purposely gone rather fully into the question of the bye-uses of electricity, because it is by their development that electricity will, I believe, before this Institute has held many more meetings, be sold for all purposes for from 2d. to 3d. per unit. I admit that I am only endeavouring humbly to prophesy, and it is for you to examine the premises which have led to my conclusions; though I would beg you to bear in mind that already in Newcastle electricity is being sold for 4d. per unit. At all events, it is certain that if the plant at our generating stations could be worked at full load, and without the intervention of electric accumulators, for twenty hours out of the twenty-four, then the electricity produced could be very profitably sold for considerably less than 3d. per unit.—even in towns like London, where coal is expensive.

But if this thing comes to pass—as, rightly or wrongly, I am convinced it will—what will be the effect on the gas undertakings? If the electricity be produced—as is now usually the case—through the intervention of steam-boilers and steam-engines, then I make bold to say the result will be to very seriously cripple at least a great number of the gas undertakings in this country. It is, I fear, too late in the day for gas companies in important towns to apply for Electric Lighting Provisional Orders, because in most cases they would be met by a counter-application from the local authority; and the latter would certainly succeed. But in Great Britain—especially in Scotland and the North of England—many of the gas undertakings are in the hands of the local authorities themselves. In some of these towns, electricity supply works have been erected by the local authorities; but in every case, with the single exception of Belfast, the dynamos have been driven by steam-engines, though in one or two instances coke breeze—which has formerly been worth little or nothing—has been used for raising steam in the boilers. In these cases, forced draught has, of course, been a necessity. No doubt this plan is economical for the present; but what of the future? What of the time when electricity comes to actually, and most seriously, decrease the demand for gas? Then the demand for electricity will be greater than that for gas; and as the demand for gas decreases, less will be made, and there will be necessarily less breeze to burn in the boilers, so that steam coal will have to be at least partially resorted to.

Hitherto, then, with the single exception of the Corporation of Belfast, no local authority appears to have recognized that there is no great advantage to be derived from founding one kind of lucrative business if that business is to proportionately reduce the profits of an existing and a paying undertaking already in the possession of the ratepayers. In my opinion, there is one way, and one way only, whereby electricity supply works can be so carried on as to permanently benefit, from a commercial standpoint, the gas undertaking. Obviously this is a consummation devoutly to be desired—at least in those cases where the gas and electricity supply businesses are in the possession of the local authority, or where (if there be such an example) both belong to the same company. In my opinion, the problem is only to be solved on a permanent and sound financial basis by the employment of gas-engines, actuated by town gas, to drive the dynamos. It may, of course, be said that if this plan be adopted, we shall be forced to employ secondary batteries and low-tension direct-current distribution, because it is frequently urged that the speed of gas-engines fluctuates too much to render direct driving advisable. Personally, I must dissent from this view, because I have had opportunities of testing the gas-engines of some of the leading makers, with the result that I am convinced of the possibility of manufacturing gas-engines whose momentary variations of speed under sudden differences of load and whose cyclical variations are no greater than those of a well-governed steam-engine. I admit that in the case of the gas-engine, an even turning moment with rapidly fluctuating loads is obtained solely by storing up, as it were, a relatively great number of revolutions in the fly-wheel—*i.e.*, by employing a very heavy fly-wheel, rendering advisable a substantial outer bearing. The result is, of course, to increase the consumption of gas at all loads, though the increase is especially felt at light loads. Nevertheless, there is a greater margin for improvement in the gas-engine than in the steam-engine; and I trust that before long we shall have gas-engines running not with fewer explosions at light than at heavy loads, but with weaker explosions, as it will then almost certainly be possible to reduce the heavy gas-engine fly-wheels, which have attained almost alarming dimensions.

But taking the gas-engine as it is, I propose to try and demonstrate the effect that would be produced in the event of a local authority owning the gas undertaking deciding to employ these engines for its electricity supply works. I assume that the electrical system adopted be the alternating high-tension system, with transforming sub-stations. Whether steam-engines and boilers, or gas-engines and no boilers be employed, the capital outlay on mains and transformers would be the same. In the case of a plant of 180 units, split up into three sets of 60 units (one spare) each, I find that the cost, using Lancashire or water-tube boilers, steam alternators (alternators coupled direct to high-speed steam-engines of the single or double acting type), a feed-water heater, and economizer is about £600 more than a plant for the same output employing three gas-engines of 110 brake horse power each, to drive the three alternators with direct coupled exciters, by means of ropes or belts. In the former instance, I have assumed that the exciter engines are to be coupled direct to their dynamos, but that the exciter dynamos are not coupled direct to the alternators. I believe that no adequate advantage would be gained by employing separate gas-engines to drive the exciting dynamos, because I am of opinion that, for various reasons which need not here be discussed, parallel running would not, in the case of the gas plant, be practicable. By parallel running, I mean two or more alternators feeding into the same main. But that parallel running of alternators is by no means essential to commercial success, is sufficiently proved by the fact that the Newcastle and District Electric Lighting Company—one of the most successful electricity supply companies in England—has never attempted it.

I do not think it unreasonable to count on a saving of about £400 in the buildings and foundations necessary to accommodate the gas plant I have just named, as compared with the outlay that would be requisite for corresponding steam plant. In the former case, neither chimney-shaft nor boiler-house are necessary; whilst in the latter, the engine and dynamo room must be rather larger, and its foundations more substantial than that for the steam plant. If, then, the total capital saving due to the employment of gas plant be £1000, and if the local authority borrow at 3 per cent. and set aside 2½ per cent. for redemption of the loan, we have a saving of £55 per annum due to the employment of gas plant. Assume that there be no public electric lighting, but that the equivalent of 6000 lamps of 8-candle power and 30 watts be connected to the mains, it is fair to reckon on a yearly consumption of 18 units per lamp. The output would therefore be 108,000 units per annum.

The following table, compiled from the Board of Trade

returns, printed weekly by *Lightning*, shows the costs of production and distribution per unit, delivered to consumers from central stations whose outputs in 1894 varied between 60,000 and 200,000 units. A Board of Trade unit of electricity will maintain an 8-candle power lamp (of 30 watts) for 33 hours.

Name of Town.	Number of Units Delivered to Consumers.	Costs of Production and Distribution.				
		Coal.	Oil, Waste, Water, &c.	Salaries and Wages.	Repairs and Maintenance	Total.
		d.	d.	d.	d.	d.
Aberdeen .	65,012	0·65	0·21	0·85	0·07	1·78
Hanley . .	65,871	0·79	0·23	0·74	0·38	2·14
Huddersfield	156,169	0·64	0·02	1·08	0·11	1·85
Taunton . .	100,495	1·95	0·48	0·79	0·32	3·54
Northampton	59,474	1·51	0·20	1·55	0·31	3·57
Scarborough	86,594	1·87	0·13	1·57	0·70	4·27
Oxford . .	157,257	0·65	0·05	0·92	0·58	2·20
Sheffield. .	192,220	1·00	0·14	1·20	0·42	2·76
Average .	110,386	1·13	0·18	1·09	0·36	2·76

As the average output of the stations named is 110,386 units, I think we may take the average costs of production as representing what might reasonably be expected to follow the completion of such an installation as I have described, using steam plant, and designed so as to economically meet the requirements of the case.

Now we have to consider what are the costs of production under the four separate heads mentioned in the table, and what the total cost of production would be if the steam plant were replaced by gas plant. It is well known that gas-engines of 100 brake horse power and upwards are now made to consume not more than 20 cubic feet of town gas per horse power per hour at full load. But unfortunately the conditions of electricity supply are such that the engines would, for the most part, be working much under full load; and I should not anticipate an average consumption of gas of less than 80 cubic feet per unit sold to consumers, taking into account the trying conditions under which the engines would be working. Now I am informed on excellent authority that 1s. 2d. is a fair price to allow as the cost of producing 1000 cubic feet of gas, including interest on capital expended on the works (but not on mains), and also cost of labour and material. I am assuming that the town has a population of about 50,000; that the electricity supply works are erected at the gas-works; and that the latter are well designed and efficiently managed. The cost of production must vary between fairly wide limits. But it is necessary to assume a definite figure for the purposes of this paper; and those engineers who know that their costs are lower or higher can make the necessary deductions for themselves. But allowing the above assumptions, the cost of gas per unit sold to consumers works out at 1·12d. per unit. In the case of the steam plant, the average cost of coal was 1·13d., and the highest was 1·95d. Oil, waste, water, and engine-room stores would probably be about equal in both cases. I should expect salaries and wages to be rather less in the case of gas than of steam plant, because in the former the wages of stokers will be saved, and the gas engineer and manager may, with a little technical assistance, manage the electricity supply works as well. Repairs and maintenance will most likely cost somewhat more for a gas than a steam plant, though the difference must be small. The saving in salaries and wages would probably rather more than cover the extra cost of repairs and maintenance. The net result, then, would be that the costs of production would most likely be almost identical in both cases; whereas the advantages, in point of view of decreased capital expenditure, and hence of interest and sinking fund, appear to me to be decidedly in favour of the gas plant.

It should also be borne in mind that the profits of the two undertakings together should rather more than cover the interest and sinking fund on their total capital expenditure; and hence if, as I anticipate, the consumption of gas will in the near future decrease in towns possessing electricity supply works driven by steam plant, then it follows that the profits from the gas undertaking must decrease also, and those from the electrical works may actually be required to pay part of the interest and sinking fund on the capital borrowed for the gas undertaking. But, on the other hand, if the two undertakings be worked so as to be inter-dependent, they must necessarily exercise a beneficial influence on one another's paying capacities. An increase in the demand for electricity will necessitate the manufacture of a proportionately greater quantity of gas. There will be a series of actions and reactions; and there will be no rivalry between the businesses of gas and electricity supply, because there will be no clashing of interests. The gas engineer will regard the electrical engineer as his best friend; and the JOURNAL OF GAS LIGHTING, the pillar of the gas world, will forget to insist on the infancy and unreliability of the electric light. Surely such a consummation is worth working and hoping for.

Discussion.

Mr. C. S. ELLERY (Bath) remarked that it was rather hard to say whether he admired most Mr. Medhurst's boldness or his sanguine temperament. He (Mr. Ellery) was a little staggered at some of the statements in the paper, which did not coincide with his own experience. They happened to know something about electricity in the town in which he was interested; and he must say that they did not see there such effects as were shadowed forth in the paper. If the electric current could be generated at the low figures suggested (he did not say it could not), it showed that very rapid strides were being made. But he should like Mr. Medhurst to explain a little further with regard to one of the towns he had referred to. He said that at Taunton electricity was being manufactured at a cost of 3½d. per unit. Now at Taunton it had been sold at 6d. a unit; and yet the concern had been in a very shaky condition for some years, and when *in extremis* they sold their works to the Corporation at about one-half of what they cost. If electricity could be produced at the low figure mentioned, and sold at nearly as much again, how was it that they fell into such a calamitous state? Of course, now they were in the hands of the Corporation; and corporations "managed" things well—very well! There was one significant item omitted from the table in the paper—nothing was said as to the return on capital; and what it would be, Mr. Medhurst would perhaps tell them in his reply. They might not be over-sanguine in suggesting that, as means were found for cheapening the electric light, improvements in some other directions might not be altogether impossible; suppliers of gas might consequently be able to improve and cheapen the light which they sold, and so live a little longer. Even during the present meeting, they had seen that, without the aid of the electric light, it was possible to produce a very brilliant light—something that would at least be creditable to gas undertakings. He referred to the "Denayrouze" burner, developing 27 candles per foot of gas consumed. Personally, he was very sanguine as to the future of some of these newer gas-lights. It would be interesting to know that the suggestion of using gas for producing electricity was actually an accomplished fact, though not quite in the way Mr. Medhurst had suggested. He had recently had a very interesting conversation with a manufacturer of gas-engines, who told him of a large factory in their district which even now was being fitted up with electric lamps, and the power was gas. He went so far as to say that some of the most formidable opponents electric light companies would have in the near future, were private installations provided with gas-engines. This was a very important point for the Institute to keep before them—to cherish and assist in every way these private installations of electric light. He agreed with Mr. Medhurst on one point—viz., that the electric light was, under some circumstances, a light that people would have, and ought to have. But whether it was to come from a central station or from gas-engines on the premises, was a question for gas engineers to assist in solving. One point was to maintain such a day pressure that there should be no difficulty in obtaining an ample supply of gas for such purposes. Some gentlemen suggested that 18-10ths day pressure was rather excessive. But in his case they maintained the full 20-10ths, and had been doing so for a considerable time; and the leakage account was only just over 4 per cent. Their day consumption for engines, &c., and for domestic purposes was from 20 to 30 per cent. of the whole; and it seemed to him that it was in this direction that they should look to meet the competition which was coming upon them. In a town he knew of, where a company was in existence supplying the electric light, the increased sale of gas this year was 3 or 4 if not 5 per cent. Therefore, from all present appearances, instead of falling into the "slough of despond," their spirits were about on the same level as formerly; and they might well believe there was some little future still before them.

Mr. JOHN WEST (Manchester) said only recently, when he was speaking on gas matters, he was told by some gentleman in the lecture-room that, of course, he was interested in gas. Now they had been listening to an electrician; and like all electricians he laid claim to have almost extinguished gas. However, he (Mr. West) did not think any amount of prophecying would do that. There was a great deal of prophecy in the paper; but he doubted if the prophecy would ever be fulfilled. The author indicated that they ought not to be sceptical, seeing there were so many local boards taking up the electric business, instead of private individuals. But it occurred to him (Mr. West) that this was a sign of weakness rather than otherwise; because if the electric light was so good a thing, he fancied there would have been more private companies taking the matter up, and showing some advantageous results in their balance-sheets. He for one should, therefore, still continue to be sceptical. He was not inclined to think that because a local authority took up a matter, it must be right. His only fear was that public authorities, having the ratepayers' money to resort to, would be not so particular as private people who were simply depending on their own pockets. He had many friends among electrical engineers in Manchester; and he was not aware that he entertained any prejudice against electricity. He did not think, as scientific men, they should be accused of not accepting what the writer of the paper supposed to be accomplished results, and of requiring to be pacified. He did not want to be pacified, in the way the writer of the paper indicated—he wanted to see some hard facts presented to him. Electricians had now been at work for a very long time; but they had not yet produced such results as to induce a large amount of capital to be invested in electrical enterprises. He believed very much in what they had done in two particulars. They had done a great deal in perfecting engines for generating electricity; and, from an engineering point of view, he gave them much credit. But it seemed to be forgotten that the electrical engineers had to obtain their force or energy from the same source as the gas engineers—they had to get it from coal; and the question was which was the most scientific and the cheapest mode of producing light from coal. He, as a gas engineer, said that he was producing it with closed vessels more scientifically and more cheaply, and that he could produce more light from a ton of coal than they could by electricity, and he had the coke to boot. There was the energy in the coal; and they had to extract it and utilize it in the best way they could. The gas engineer retained most of its properties in the shape of gas, coke, tar, liquor, and other things; whereas the scientific electrician asserted that he first of all used coke, or coal, or breeze under the boilers to generate steam. What heat did he get out of the coal there? Then, again, the steam was taken to the engines; and however admirable they might be, there was a considerable loss there. Then he went on to produce his electric current; and so he was carrying forward and losing part of his energy through a long series of mechanisms. It was not for him (Mr. West) to despise mechanics, because he was almost living by the application of mechanism properly applied; but in this case he did think it was a little divergent from the straight course. Mr. Medhurst had prophesied that if people would use the electric supply during the whole 24 hours, so that they could maintain a full load on the engines, then they might reduce the cost of electric lighting. But gas engineers might say the same thing—if people would use the same quantity of gas hour by hour through the 24 hours, they would have their distributing plant fully occupied, and so be able to dispense with holders altogether for storing the gas. Then there was another "bogey" raised up about heating by electricity. They had no doubt seen the frying of a pancake or some little thing of that kind; but he should want a lot of that sort of food to satisfy him. What he wanted to see cooked by electricity was a good thick steak. When the electricians could do that as cheaply as by gas, there would be some probability of electricity coming into competition with gas engineers. As to the likelihood of reducing the current to 2d. or 3d. a unit, that was sheer imagination. They had heard the same sort of nonsense talked time after time. The question was, could they as gas engineers make gas to compete against the electric light? and it was well known that they could. They had shown by the introduction of new burners and so on that, instead of the electric light approaching them, the distance between them was getting greater and greater. He looked upon the electric light as a kind of luxury, for which some people no doubt were willing to pay. Mr. Medhurst had indicated that he thought the gas-engine was the best means for producing the requisite power. But that was no novelty. Mr. Denny Lane had pointed it out many years ago; and he (Mr. West) had repeatedly done the same thing in Manchester. There were a great number of installations in London and other places where gas-engines were being already used for the purpose. There was no doubt that, in either small or large installations within small areas, a gas-engine would be more economical, because of the great loss which always occurred in distributing the electric current. The advantage of only having to distribute it within a few hundred yards was one of the conditions which electricians were trying to bring about. They could convey more horse power through gas-mains, and much cheaper, than the electricians could through the cables they laid down for the electric light. In the table given in the paper, he noticed a very great difference in the cost of production in different places; and he should be glad if the author could give a reason for the difference. At Taunton, it was 1·95d.; at Scarborough, 1·87d.; and at Oxford 0·65d. He (Mr. West), could not understand why this difference arose, because there was not a corresponding difference in the price of coal to account for it. Perhaps in one case they were using expensive coal; and in the other, coke or breeze. At the end of his paper, the author suggested that the time might come when electricity would be able from its profit to assist the gas industry; but, at any rate, they already knew of several instances where the gas department of a town had had to subsidize the electric light. He should like some instances to be given of dividends being paid by electric companies for supplying the electric light. In conclusion, he must again repeat that he was not prejudiced, and it must not be assumed that any of them were prejudiced, against electricity; they came there for scientific purposes. The gas engineer and the electrical engineer were brothers in arms; and it remained to be proved which would be the most successful.

Mr. Alderman MILES (Bolton) was not prepared to take the sanguine view which Mr. Medhurst did. On the other hand, he was not prepared to be so severe on the electric light as Mr. West. He thought, as the result of his experience, that the middle course would be nearer the truth. No doubt many of the members had studied the paper read by Mr. Chew, of Blackpool, at the last meeting, when he (Mr. Miles) made a statement as Chairman of the Bolton Corporation Gas and Electricity Committee (for they had combined the two together), that he would take care, if it was within his power, that the gas department should not subsidize the electric light department. In that endeavour, he had partially succeeded and partly failed. They had now had four months' full working of the electric department—it having been opened in October—and, in making up their accounts to the 25th of March, they had four months' good working. He was rather pleased to observe that the accounts turned out fairly well. If the Local Government Board did not compel them to repay their capital in 25 years, they would have been able to meet every charge in the way of establishment, and everything else, and be only £11 to the bad for the first four months' working, which was not so very bad. Their charge per unit was about 5½d. The works were admirably well placed. They used breeze for the boilers. He believed that electricity had "come to stay;" and that they must make up their minds to this being so. He was not at all afraid that the supply of electricity given by public companies or corporations would in the long-run materially affect the supply of gas. Their increase this year in the gas supply had been 4½ per cent.; and the profits were larger than ever before. On the other hand, he was inclined to agree with Mr. Medhurst somewhat that these conditions would not be so nearly allied as they were at present; and he could scarcely agree with what Mr. West said, that the gas industry was beating the electrical industry. Of course, that was a problematical question; and after the lecture they had had from Professor Lewes, describing an improved burner and the marvellous advances made in gas-heating, it was impossible to say what would be the result. Speaking generally, however, they might fairly believe that gas would hold its own. One of the chief difficulties that

arose was one which occurred in their own town—namely, the probability of mills and other large works providing installations of their own, and working them by their own engines. They had a case in Bolton last year, where they had lost a consumer of £500 a year; and the manager of the concern informed him (Mr. Miles) that he was entirely satisfied with his own installation of electricity. Of course, they could not hope in cases like this that gas-engines would be used to supply the power. In small private installations, gas-engines would do very well; but it was in the case of the larger works that he saw danger ahead. He was very much interested when Mr. Chew read his paper, in the suggestion that there would be a probability of gas-engines being used for the purpose of central station lighting; but he had not heard of it yet, except in the case of Belfast. He should be very glad to know if the engine used there was satisfactory. They did everything in their power at Bolton to induce the electrical engineer to adopt a similar plan; but, after the most elaborate inquiries, he failed to find a gas-engine which would answer his purpose, though he was desirous of doing so. No doubt, if such a thing could be done, it would be a great boon to corporations and gas companies. Taking the thing as a whole, he should not have had the temerity which Mr. Medhurst showed when he talked about electric works being called upon to pay part of the interest and sinking fund on the capital borrowed for gas undertakings; and he did not consider they need be alarmed at the statement. He did not think that it would come to pass at any rate within the next ten years. To return to what happened at Bolton, with regard to the gas department subsidizing the electric department. There was a deficiency of something like £580—being the amount of capital which had to be repaid. This had to come from somewhere; and while he was very anxious that it should be carried over to the next half-year's account (to see how the accounts would work out), the Town Clerk advised him that it could not be done—that it must be provided out of the rates. It had therefore to be so arranged for; and as the Gas Committee handed over the sum of £23,000 in relief of the rates, out of that amount had to come the £580. He was right in saying, therefore, that he was partially successful, but not wholly so, in preventing the subsidizing of the electric department by the gas department.

Mr. Isaac Carr (Widnes) said not only must they all agree that the electric light had come to stay, but they must also accord it the first place as to the quality of the light it afforded. Everyone who had seen the charming effects obtained by the electric light in window decoration, knew that such effects were impossible with gas-light; and the electric light would therefore always hold the first place on that account, and gas must come second. He was sorry he could not speak of the other portions of the paper so favourably, but must follow somewhat on the lines of those speakers who had taken an adverse view. It had been said that the cheaper production of electricity depended on the more constant use of the generating plant. But they also knew that, if gas plant could be kept working at anything like its maximum capacity, how much cheaper gas could be supplied. There was one important point in the paper to which he wished to take exception—viz., the excellent authority who had given Mr. Medhurst his figure of 1s. 2d. as the cost of 1000 cubic feet of gas, including interest on capital, and putting the gas into the holder. The figure of 1s. 2d. might be the average cost; but he (Mr. Carr) could assure Mr. Medhurst that there were works in this country where the cost, including all charges, was 30 per cent. less than the figure he had named. That being so, if really active competition came into the gas industry, as it had done in other trades, what was possible in gas production would of necessity become much more general. From what they had recently seen as to improvements effected for cheapening cost of production, it was evident that gas was just as much in its infancy, and as capable of development, as electricity; and he (Mr. Carr) could not see that electricity was any more likely to check the consumption of gas than gas had been able to reduce the consumption of candles and oil.

Mr. J. Stelfox (Belfast) did not think it would be right for him to attempt to answer directly the question put by Mr. Alderman Miles, as it did not refer to his department. He had in recent years asked for an increase of producing power in gas-making, and had consequently been put down as an opponent of the electric light under all circumstances. But he had only asked for what he thought was needful for their own industry; and he did not at all regret to see the electric light extended. As it was a separate department in Belfast, he did not care to give figures, which should come from the head of that department. He might say, however, without going into the figures, that in the only quarter's running of the electric light installation at Belfast (and it was not a full quarter), the gas bill amounted to one-half the total accounts for the electricity, and the increase in gas consumption for that quarter was fully twelve times the amount of the bills sent out for electric lighting. Mr. Medhurst had assumed that people would be disposed to take the electric light on account of its extra brilliancy; and no doubt the electricians could make a very beautiful display, when they had on a small table as much light-giving power as was generally distributed over a small parish. But when the light was taken off the tables, and put at intervals through the streets and shops, he (Mr. Stelfox) did not see where the superiority came in. A few evenings previously, he was in the Belfast Exhibition, which was supposed to be very brilliantly lighted with arc and incandescent lights; but there was not a second opinion from anyone he had spoken to who had been in the place, as to the fact that the small stand of the Incandescent Gas-Light Company was the most brilliant thing in the exhibition. It stood out even amidst the arc lights, and attracted attention to itself right across the building. Accompanied by Mr. Denny Lane, he went through the exhibition; and the parties themselves admitted that the picture gallery, which was entirely lighted by means of incandescent electric lights, was simply not lighted at all. The question had been naturally asked, Why did not the Incandescent Gas-Light Company put up a few lights there? Now, with regard to private installations. In the very centre of the small compulsory district of Belfast, he had just jotted down the names of five large firms who were using the electric light. Four of them employed gas-engines in its production; and one, an extensive steam installation. He thought he was correct in saying that the united energy expended in these five places was considerably more than was going out from the public installation. In one case, they had two 8-horse power nominal gas-engines; and in another, two 20-horse power nominal engines. There were many cases all through the town; but these were in the very midst of the compulsory lighting district. The adoption of electric lighting by corporations was no proof that real progress was being made. Letters were written to the newspapers, and people insisted that the electric light should be adopted, so that they should not be behind others. In this, people who knew nothing whatever about it, were unanimous; and so it got done. Some years ago, electricians were very keen to start companies; but now they were much keener to experiment with public money. One gentleman said he thought they would make money if they had not to repay loans. That sounded like saying that people would all be very well off if they had not to pay their debts. In that case, they would all be content permanently with their present salaries, or even less.

Mr. C. A. Craven (Dewsbury) said, in the town he came from, they were a very "happy family" so far as lighting was concerned—both gas lighting and electric lighting were under the local authority. He was very pleased to hear from Mr. Medhurst that there was a prospect of them having some assistance towards paying the interest and the sinking fund of the gas-works from the electricity works, if such assistance should ever be needed. At present, the "boot was on the other leg;" but how long it would continue so, he really could not say. He did know of a case where the electricity department got some assistance in paying their interest and sinking fund from the gas department, and even occupied a portion of the gas-works without paying any rent. When the project for introducing the electric light was first mooted, it was discussed by the Lighting Committee; and the matter was referred to him. He said by all means introduce it; he was not afraid on account of the gas-works. But how the electric lighting would succeed, he did not know. Then an eminent electrical engineer was consulted; and they were very good friends. But the electrical engineer recommended that the gas-works should be simply utilized for heating, cooking, and motive power purposes, and electricity for lighting. Some of the Committee asked him (Mr. Craven) what he thought about that. He told them if anything of the kind were adopted,

he had one special recommendation to make, and that was that each of them should purchase a strait waistcoat, get put into it, and then retire into private life. However, they were getting on very amicably. The gas-works were none the worse for having the electric light brought into the town; and if there were any anxiety, he thought it was rather on the other side. No doubt, electric light would progress; but if not, they would have to continue the little bonus towards assisting them. One thing he felt sure of—that if they could once get hold of a good consumer, they would get twice as much out of him as the gas-works did. At the same time, he was anxious to know where an electric light station had injured any existing gas-works. He did not know of any, although he had tried to find out if such a case existed.

Mr. Joseph W. Buckley (Falmouth) said he should like to mention one or two points which had come under his observation—particularly one or two private installations. He found that in no case had the private installation been taken advantage of by the electric light except where the worst possible system of gas lighting had been continued in use. Like Mr. Ellery, he thought private installations ought to be encouraged, because his experience was that, where gas-engines were used, more gas was used for driving the engine than had previously been used for illumination. This probably arose from the fact that the consumers mentioned had used the gas most sparingly when consumed for lighting. The surprisingly low price per unit mentioned by Mr. Medhurst was very far from coinciding with a tender he had noticed some months ago from an electrical engineer for public lighting a street in the West of England. The cost he estimated for lighting the streets a mile long was about as much as the authorities were paying for the lighting of the whole town, about eight miles of streets, by means of gas.

Mr. Denny Lane (Cork) said that he would try to avoid repeating statements which he had made before. They might remember that at Belfast two years ago, when in the presidential chair, his address was principally devoted to this question of the application of gas for producing electric light; and he showed clearly, as he thought (at any rate no one had ever contradicted any of his statements), that whether for the production of electric light, or perhaps still more for its distribution, gas had special advantages. He then showed how by gas they could distribute some 3000-horse power a distance of a mile at an extremely low rate; and he pointed out how much cheaper it would be to have several stations than have only one very large station, with expensive conductors and feeders. He could corroborate what Mr. Stelfox had said with regard to the lighting of the Belfast Exhibition. He had always been exceedingly fond of pictures; and there was a nice collection, he believed, in the exhibition. But he must confess that he was totally unable to see them by the electric light. There were a great number of incandescent lights; but really the paintings were only semi-illuminated. One of the most brilliant displays he ever saw of artificial light of any kind was that from the stand of the Incandescent Gas-Light Company in the same exhibition; and, of course, there were a good many lights on it. One gentleman asked whether there was any case in which the consumption of gas would be diminished by the introduction of the electric light. He remembered one case where after its introduction, but certainly not on account of it, the gas consumption had been diminished; and that was in the important city of Berlin. Soon after the electric light was introduced, the gas consumption diminished; but the authorities attributed it—not to the electric light, but to the great economy of gas in consequence of the substitution of incandescent gas-burners for old-fashioned ones. Berlin and Amsterdam were visited two years ago by some of the Directors of his Company; and in both places they found that establishments which had previously been lighted by the electric light were then supplied with incandescent gas-lamps on account of their superior economy. He had taken a short note of what the difference might be between the very best gas lighting and the electric light. If the electric light were reckoned at 6d. a unit, which was a very moderate price, and each candle taking $3\frac{1}{2}$ watts to supply it for 1d., they had 50 candles of supply. On the other hand, taking gas even at 3s. 4d., or 25 candles for 1d., and in the burner shown the previous day, there were 27 candles given from one cubic foot. Therefore, on the one side there was for 1d. 50 candles of electric lighting, and 540 candles by gas-light. Of course, he was taking the best condition of burning gas; but putting it down at half that, electricity cost about five times as much as gas-light. He did not know what the reason was, but undoubtedly the electric light had some effect on the imagination; because, as someone had remarked, there was a very great tendency to prophesy among electrical engineers. Among the most imaginative of them all, perhaps, was Mr. Preece. He told them the other day that the electric light was essentially a poor man's light. He (Mr. Lane) had not found yet that it had proved itself to be so. He might remark that the city of Waterford was supplied with the electric light some eight or nine years ago; the Corporation having made a five years' contract with the Electric Lighting Company. But as soon as the contract terminated, the electric light terminated too; and there had been no electric light in Waterford for several years. There were a good many small installations in Cork; and in every case, except in flour-mills, the power was supplied by gas-engines. He could not see any unsteadiness or any unpleasant effect from using gas-engines, if they were properly attended to. They had a great many gas-engines in Cork; and they had one very capable and intelligent mechanic who thoroughly understood their construction. He periodically visited all the engines, and discovered if there were any defects. In consequence of this, they worked very much better than ordinarily. In one case recently, he was sent for—where any delay would have been of great damage to the business—to inspect the gas-engine. When he came back, he was asked if there was anything wrong with the engine. He replied that it was only the gas supply that was wrong—there was not sufficient gas; the air supply was wrong; the water supply was wrong; and the exhaust was wrong. That was all that was wrong. They never had complaints from any place where the electric light was supplied. Someone said he had heard of no other place where the electric light was supplied through gas-engines except at Belfast; but he (Mr. Lane) might mention that at Dessau, in Germany, it had been supplied for many years by gas-engines, and had given great satisfaction. At Belfast, the experiment was very practical. There were four engines of 100-horse-power, and two of 50-horse power. The whole of these might be required at night; but during the day one of the smaller ones was kept charging an accumulator. When there was an accumulator running parallel with the engines, there was improved steadiness with the light. Steam was employed at the Crompton Company's works at Kensington, and several other places. Besides the advantage of allowing the engines to remain unemployed for some time, it certainly steadied the light. With regard to distribution, he had always been in favour of the low-tension continuous, as compared with the high-tension alternating system. It was much better to distribute the generating stations in such positions that the current from them should not have to go more than three-quarters of a mile. Within that distance, it was quite easy to supply all, by means of gas-engines which required but little attention. That was another point which had not been referred to—the small amount of attendance necessary for a gas-engine. In point of fact, if the time of a man who had to take charge of the steam-engine and boiler in a small installation was reckoned, it would come to more than the whole gas would cost to supply the station. With regard to the supply of power also, except for very small motors, it could be very much more easily supplied by gas-engines than by any electric motor he had ever seen. As to cooking by electricity, it was one of those things which he deferred forming any opinion about, until he saw a baron of beef properly cooked by it. He would remark, in conclusion, that the paper seemed to avoid the question of the incandescent gas-light, which was the most serious opponent electricity had ever met with. He had seen many lamps which gave a purer and whiter light than the electric light itself— more especially those he saw a few days before in Belfast; and he had very little doubt that if the new process shown by Professor Lewes was carried out, of mixing the gas and air more thoroughly, the days of the electric light would be numbered. He should be sorry for that, however, because he believed in competition. As an evidence that he had no objection to electric lighting, the Directors of the Company with which he was connected, on his advice, had on two occasions applied to the Corporation for their

assent to the Company applying for electric lighting powers; and they were going to apply again this year. The consent of the Corporation was not necessary; but they should not like to get into conflict with good consumers. This, at any rate, was evidence that he had no prejudice whatever against the electric light; he believed it to be the best friend gas had ever had.

Mr. FRANK WRIGHT said, as a visitor to that august assembly—casting the "sandals of trade" from off his feet—he desired, with the permission of the President, to make a few remarks upon the subject of Gas *versus* Electricity. In the first place, they well knew the adage that a prudent general never despised the strength of his adversary; and they should also remember the fable of the tortoise and the hare, in which the poor despised tortoise, by perseverance, overtook, and left far behind, that fleet animal, the hare. Many years since, attracted by the effulgent rays of an electric arc lamp, and desiring to know something more on the subject, he made a call upon the company exhibiting the light, with a view to employment; and he ultimately succeeded in becoming assistant in the physical laboratory of Mr. St. George Lane Fox—a gentleman he had previously known in connection with the system of automatically lighting and extinguishing the gas-lamps in Pall Mall about the year 1876. No sooner did he (Mr. Wright) meet this gentleman, than he was advised to insist upon all his friends selling out their gas stock. However, not being a believer that electricity would ever entirely displace gas, he did no such thing. Many unfortunate beings, however, were at the time led into parting with their shares; and others more fortunate took advantage, and secured them. It was a fact that at this time many of the gas companies had never paid a higher dividend than 10 per cent.; whereas since the healthy competition of electricity, they had paid as much as 14¾ per cent. There were different classes of light as in other things; and they now had the incandescent gas-light competing with the incandescent electric light. He, however, always believed in having the best of everything. Mr. Denny Lane had but a few weeks back entered into a discussion with him on the question; and that gentleman had clearly proved that the average charge for electricity in some of the principal cities and towns was not more than 4d. per unit, this being what he (Mr. Wright) paid for the current he used for lighting and power. A previous speaker had mentioned that an ounce of practice was sometimes worth a pound of theory; but he (Mr. Wright) thought that, when practice fully supported theory, a more satisfactory state of affairs existed. As affecting the practical side of the question, he might mention that the Army and Navy Stores were replacing some 8000 incandescent gas-lights by incandescent electric lamps, on the score of economy.* Mr. John West had on several occasions endeavoured to show that electricity was many times more expensive than gas. This, however, did not agree with his (Mr. Wright's) opinion; for having been called in on various occasions to closely investigate the question in several large mills in Lancashire and elsewhere, he had no hesitation in stating that the useful available light from incandescent electric lamps, with energy at 4d. per unit, in comparison with flat-flame burners with 16-candle gas costing 2s. 6d. per 1000 cubic feet, was some 25 per cent. cheaper. Had there been a blackboard in the hall, he would have demonstrated this. He concluded by saying that the gas suppliers had it in their own hands to make a good fight; but he for one did not believe it was to their advantage to supply a low quality of gas at a reduced price, and then to leave it to a company such as the Incandescent Gas-Light Company to absorb a large amount of the profits due to the light by the supply of mantles, &c., for enrichment (so to speak), which might with much more advantage to themselves be replaced by rich gas made from the oils and cannels at their disposal.

* With reference to this part of Mr. Wright's remarks, the Secretary of the Incandescent Gas-Light Company, Limited, has since stated that the Army and Navy Stores never at any time used 8000 incandescent gas-lights; that they have never reduced the number of these lights in use; and that their premises are not lighted by electricity, with the exception of the basement, where the electric light was installed after the Company had represented to the Secretary of the Stores that it would be more suitable in that position than the incandescent gas-lights. With regard to Mr. Wright's subsequent remark as to the comparative cost of gas and electric light, it has been pointed out that, with gas at 2s. 6d. per 1000 cubic feet and electric current at 6d. per unit, the Welsbach system produces a given light at from one-sixth to one-eighth the cost of electricity; while the ordinary flat-flame burner produces an equivalent light at about one-third to one-half the cost. —ED. J.G.L.

Mr. W. W. HUTCHINSON (Barnsley) suggested that, if gas lighting were abolished, the question would arise, where they would get the enormous quantities of coke, tar, and liquor which formed such an important feature in the commerce of this country. It appeared to him that special works would have to be put up to supply the coke, tar, &c.; and in that case gas would be the bye-product, and would at once come into competition again with electricity.

Mr. MEDHURST, in reply, said he was much obliged for the courteous hearing which had been given to his remarks. They must admit that for the time being they were on different sides. But, nevertheless, this need not prevent their working for the common good; and he was pleased to see that there had been an entire want of acrimonious feeling in the discussion. He had tried to keep anything of that sort out of his paper; and judging from the discussion which had followed, he almost thought that he had succeeded. Mr. Ellery asked him to explain the low cost of production at Taunton; and he drew attention to the fact that the Company had sold electricity at 6d. per unit, and had not been able to make it pay, even though their working expenses were not more than 3½d. per unit. He was not quite sure if Mr. Ellery meant to dispute the figures given in the paper. They were not his figures; they were printed weekly by the paper *Lightning*, and were compiled from the Board of Trade returns.

Mr. ELLERY said he did not dispute the figures. He only wanted to know how it came about that the Company made a loss, if they produced electricity at 3½d. and sold it at 6d.

Mr. MEDHURST said he was not aware that they did make a loss on their year's trading. He did not see how it was possible, seeing that they made electricity for 3½d. according to the Board of Trade returns. Every electric supply undertaking had to furnish to the Board of Trade a yearly record of their working expenses, and their revenue; and these analyses were simply based on the returns made to the Board of Trade. He thought there must be a mistake in saying there had been a loss at Taunton.

Mr. ELLERY said it appeared by the balance-sheet.

Mr. MORTON suggested that the question of capital did not come in, which might account for it.

Mr. MEDHURST believed the works at Taunton still belonged to the Company when these returns were made; and the question of the redemption of capital in the case of a company did not come in. A company was not in the position of a corporation, having to return its capital in 20 or 25 years' time. They had to set aside a certain sum for depreciation or redemption; but that was entirely an optional matter in the case of a company. The difference between 3½d. a unit, which it cost them to produce, and the various prices they received, was profit, with the exception that they had to make allowance for depreciation, rent, and directors' fees. If there had been a great loss, he did not think the Corporation would have been as ready as they had been to buy up the concern, though the figures he gave in his table only represented works' costs.

Mr. ELLERY remarked that the Corporation gave about half the amount of the Company's capital after they had been losing money for years.

Mr. MEDHURST said he could not accept these facts at present. They had also been informed that morning that gas would become cheaper. No doubt it would become a great deal cheaper; but even if it did, that rather tended towards strengthening his argument. He believed the electric light in the future would decrease the consumption of gas. Some gentleman asked for data with regard to that statement. Well, at Birmingham the effect had already been felt. The increase in the consumption of gas had not taken place as it had done formerly.

Mr. CHESTER said last year the Birmingham Corporation had an increase of about 5 per cent.—an increase they had not had for a long time.

The PRESIDENT drew attention to the fact that Mr. Medhurst was replying to the discussion and must not now be cross-examined.

Mr. MEDHURST said in 1894 there was a decrease in the gas supplied, compared with 1893. It was difficult for any man to say absolutely what the reasons were. But they knew the consumption of the electric light had increased very much in Birmingham; and he thought it was not unreasonable to suppose that the diminution in the consumption of gas between 1893 and 1894 might be attributable, in some measure, to that circumstance. Of course,

that was a matter of opinion. Mr. Ellery asked where town gas had been actually used for supplying electricity from central stations. It was being used; but he could not give any returns as to working expenses. The fact was he could not give any returns as to the effect, as the only town in the United Kingdom was Belfast, and the works had only been in operation for three months. Then it was suggested that gas-engines ought not to be used to produce electricity from central stations, but to produce it on the consumers' premises, or at several small central stations in the same town. That, he thought, was altogether erroneous. If there were five gas-engines in a central station, they might very easily be run by employing two men. But if there were five gas-engines in five different spots in a town, they could not possibly be run with less than five men. The cost in labour was very much less by placing the engines in a central station rather than by placing them in cellars or specially-built engine-houses. Again if, as Mr. Lane suggested, they were put, not in the consumers' premises, but in a series of central stations or decentralized stations for supplying the electric light, there was the same difficulty, and there was the additional difficulty of obtaining land in some six, seven, or eight places for the works, which was much more costly than providing one plot on which to erect one good-sized station. Altogether he thought the working expenses would be considerably greater if Mr. Denny Lane's plan were to be adopted. Coming back to Mr. Ellery's remarks, the reason why the electric lighting at Bath had not been entirely successful, was that the station there was one of the earliest erected in the country. It was put up by a Company who had something to prove. They did prove to the satisfaction of people resident in Bath that the electric light could be supplied steadily without making a loss, even in those early days; and the best proof of the satisfaction that the people of Bath felt with regard to it was that the Corporation had, on his (Mr. Medhurst's) advice, passed a resolution refusing their assent to the Company's application for a Provisional Order, and stating their intention to apply for a Provisional Order themselves. Whether they would buy up the Company's works, or start new works of their own, did not matter for the purposes of his argument. Mr. West remarked truly that no amount of prophesying would extinguish the gas industry. He had not attempted to create the impression that electricity was going to extinguish the gas industry; but he did believe that the demand for electricity would decrease the demand for gas in towns possessing steam-driven electricity supply works. But still he thought that, even when this happened, the demand for gas would be very considerable. They had in the gas industry what they had not in electricity—a very valuable acquisition in the bye-products. Probably there were cases in which a gas supply undertaking either in the hands of a corporation or a company could almost afford to give away the gas because of the large revenues they derived from their bye-products. But if anybody used the electric light where they formerly used gas; it did not require an intricate argument to show that, to that extent, the demand for gas was reduced. Those gentlemen who saw in his paper an attempt to show how the demand for the electric light might take place without decreasing the supply of gas, had really discovered his meaning. Mr. West wished to know why private companies had not taken up electric lighting; and he said the fact of corporations taking it up was to his mind a proof that capitalists and financiers were afraid of placing their money in such undertakings. It was all very well to say that companies preferred throwing off the burden; but suppose corporations would not accept the burden! They had accepted it; but not before private capital had shown what it could do in the way of making the electric light pay. The Newcastle Electric Light Company had paid dividends from the very first year. The first year, they paid 2½ per cent.; the second, 4 per cent; the third, 4½ per cent.; the fourth, 5 per cent.; and last year they paid a dividend of 6 per cent. Their business had increased; and the cost of production had decreased.

Mr. West asked if that was purely and simply out of the products of electricity, or for apparatus supplied.

Mr. Medhurst said it was purely out of the profits of supplying electricity. The Company did not supply fittings at all at Newcastle. Take again the London Companies. To the best of his recollection, there was only one London Company that was not paying a dividend—that was the London Electricity Supply Corporation, which was a scheme entirely by itself. Instead of using engines of 100, 200, or 300 horse power, they used engines of 1000-horse power, which did not prove successful. All the normal London Companies did pay dividends varying from 3 to 6½ per cent. Electricity supply had proved to be a paying concern before there was this great outburst of municipal fervour in the erection of electrical works. Mr. West said that gas could be obtained more directly from coal than could electricity. With that view, he (Mr. Medhurst) did not agree. They were also told, and quite rightly, that the gas companies would benefit as much as the electric light if they could work at full load. Of course, that was so. The point was that even now the load-factor of the gas companies was much higher in the great majority of cases than at the electric lighting works; and they hoped in time to very much reduce that. Mr. West also said that the difference between the cost of producing gas and electricity was getting larger instead of smaller. If he meant that the cost of producing gas was decreasing more rapidly, and the cost of producing electric light growing only slowly smaller, he could not absolutely deny the accuracy of his remark, because he did not know in what ratio the cost of producing gas was decreasing at the present time, but he did know that in every instance the cost of producing electricity was decreasing. It was said that there was nothing new in using gas-engines. He had never claimed any novelty for the idea. He said quite openly that there was one instance in which gas-engines were used not only for producing light, but in a central station—viz., at Belfast; and they also heard that it was being done on the Continent. He had not attempted in his paper to bring forward anything new; but he thought it possible to do something profitable without doing something new. If they would inquire a little farther into the matter, they would find that, although not new, it was certainly profitable to use gas-engines actuated by town gas to produce electricity, rather than steam-engines, in cases where the public authority already possessed the gas-works. Then they were told the loss in distribution was very much greater in the case of electric lighting than in the case of gas lighting. That was a mistake. The loss in distribution—if by "loss" was meant the loss in the mains—was certainly not on an average more than 5 per cent., or rather less. It was only the amount of copper that was put into the mains which governed the actual loss. It might be possible to sink enough capital in the mains to make the loss practically negligible; but it was not found convenient to do so. The increase in capital was too great; and so, in the majority of cases, the loss on distribution was about 5 per cent.—not more, and probably less. As to the dividends, he had partially answered that aspect of the question already. He had told them of the Newcastle Company; and he might add that there was a second Electric Lighting Company at Newcastle which had regularly paid about ½ per cent. less than the one mentioned. Nearly all the London Companies paid very good dividends, and many Provincial companies as well. At Portsmouth, the first year's working showed a profit, which, had the undertaking been in the hands of a company, would have paid rather over 5 per cent. It paid the whole of the interest on the capital sunk, and almost the whole of the sinking-fund for the first year. The Corporation had only to make up ½ per cent. out of the rates for the first year's working. Most gas undertakings in the country did not pay dividends of five, six, or seven, or even of 1 per cent. during the first years of their existence. Mr. Craven remarked that the electric supply works in his town were not charged any rent for the ground on which they stood, and, even under those conditions, they were unable to pay their way. He (Mr. Medhurst) was quite ready to take Mr. Craven's word for it; but he expected to see very great improvement in the near future if that were the case. The question had been raised as to the practicability of cooking and heating by electricity; and one or two gentlemen actually said that, when they saw it, they would believe it. That was very hard on electricity; because they might see it if only they liked. They could see it in London or even in Edinburgh; but if they would not take the trouble to go and look at it, it was a little hard to say they would not believe it unless they saw it. It was perfectly visible, and might be seen every day. It was, too, very economical, as he could show by figures. He knew the cost of cooking by gas; and he knew the cost of cooking by electricity. An electric hot-closet, large enough for a good-sized family,

only cost 2d. an hour. Taking the current at 5d. per unit, an electric grill which required ten minutes to heat up and another ten minutes to cook two chops—or 20 minutes in all—cost less than 1d. When the grill had once been heated, it could be kept in constant use cooking every ten minutes at a cost of only ½d. With a cooking current at 4d., the above operation would cost 20 per cent. less. Mr. Denny Lane said he found the electric light did not illuminate pictures well in the Belfast Exhibition. With all due deference to him, that was no objection, because it was evident the lights were not properly applied. The right way to light a picture was at the bottom with a shade to reflect the light upwards, and not from the top. At Berlin, as Mr. Lane had said, the consumption of electricity for some cause had decreased the consumption of gas. Then Mr. Lane remarked that, for an outlay of 1d., 540-candle power could be had for an hour out of gas; and he then compared that with incandescent electric lighting, which he said was about ten times as great. That might be so; but Mr. Lane had taken the most economical form of gas-burner, and the most uneconomical form of electric illumination. He should have compared the gas illumination —not with the incandescent light, but with the arc light; and then he would have found that, for 1d. per hour, he could get 800-candle power out of the arc light, as compared with 540 candles out of the gas light. He (Mr. Medhurst) was pleased to have Mr. Lane's testimony to the fact that gas-engines were really capable of running steadily; though he did not agree with him in his objection to using alternating currents with high tension, and preferring low-tension currents with accumulators. He was sorry to say that electric accumulators were far from economical. They cost a great deal in the first instance; and the depreciation was very heavy. There was a loss in every conversion of energy. The more one converted energy, the more would the ultimate cost become. He was glad to hear that a Provisional Order was to be applied for in Cork; and it was quite evident they might have one instance in Great Britain in which the same Company would be supplying both electric light and gas. Mr. Miles's remarks were, on the whole, encouraging; at any rate, he showed that even at Bolton, where the electric light had only been running for four months, they had more than paid their expenses. They had earned a dividend, and had almost paid the sinking-fund. That did not compare badly, he thought, with the first four months of any gas undertaking they might select. He concluded by again thanking the members for the kind reception they had given his paper.

Water-Gas Plant in Sweden.—The first installation of water-gas plant in Sweden has just been completed at the factory of M. de Laval, for incandescent electric lamps. The capacity is about 4250 cubic feet per hour.

The Direct Determination of the Weight and Volume of Gases.—A recent number of the *Chemiker Zeitung* contains a notice of an apparatus patented by Messrs. Krupp and Co. for the direct determination of the weight and volume of gases. The state of tension of a volume of gas enclosed in a vessel is transmitted to index mechanism, in the manner of an aneroid barometer, and to a scale which shows any change of volume or weight. The scale is graduated so that expansion of volume can be read off in 0·01 of the unit of volume at 0° C. and 760 mm. pressure.

The Oil-Gas Experiments at Bradford.—Referring to the paragraph on this subject in the last number of the JOURNAL (p. 100), the Chairman of the Gas Committee of the Bradford Corporation (Mr. W. C. Dixon) writes that it is incorrect, "as there was no misunderstanding between Dr. Dvorkovitz and Mr. Lewis T. Wright." He says "the Doctor was solely responsible for what took place in regard to stopping the test." We learn from a local paper that, according to the minutes of the Gas Committee adopted at last Tuesday's meeting of the Town Council, arrangements have been made for an entirely fresh test of the Dvorkovitz process to be carried out.

The Miners' Federation and the Eight Hour Bill.—The General Secretary of the Miners' Federation of Great Britain (Mr. T. Ashton) has issued a manifesto, in view of the General Election, reminding the members of the Federation of their pledge not to vote for any candidate who objects to support the Mines (Eight Hours) Bill. He reviews the progress of the Bill since its introduction in 1892, and expresses the opinion that it has been encouraging. He asks that the operations of the measure shall extend as far as those of the Mines Regulation Act. No district, he thinks, should be exempt; and there should be no local option. He is desirous that all colliers shall work the same length of time—viz., eight hours from bank to bank; and he thinks that if the members of the Federation enter the present contest with an earnest determination to win, they will succeed.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 149.)

THE main characteristics of the past week on the Stock Exchange were very like those of the preceding week. Business in general was very far from being at high pressure; and the attendance was not as full as it might have been, owing in some degree to many counter-attractions of field and river. But nothing could stop the upward march of prices; and, while all departments were good, the chief places were again held by the two extremes of the choicest gilt-edged and the speculative mining adventures. Consols once more broke the record by changing hands on Wednesday and Thursday at 108; but unless some unexpected bolt from the blue should fall, even that figure will probably be beaten ere long. A very slight reaction was perceptible towards the close of the week; but nothing is likely to come of it. The settlement, big as it was, presented no difficulties; and any amount of money could have been had without producing any impression on the market. Business in the Gas Market was decidedly more quiet—stock generally being scarce; and, with the important exception of the leading issue, firmness was the feature. The greatest advances in value were made by the debenture stocks—a move which is likely to continue so long as the present condition of the Money Market lasts. A noteworthy incident is the fact that on Friday the Gaslight and Coke 6 per cent. debenture stock changed hands at over cent. per cent. premium; thus beating a 3 per cent. for money price. South Metropolitans did this some six months ago; and now Commercial is hurrying up after them. Gaslight "A" was rather inactive and flat; and on Friday was done as low as 283. The secured issues, however, were brisk, and made other nice advances beyond that already noted. Very little was transacted in South Metropolitans; but the "B" pushed up another couple of points, and the debenture was done at higher figures *ex div.* than those quoted with the dividend in them. Commercials as usual were quiet, there being no stock to deal in; but some debenture changed hands at a fair advance. The few dealings marked in Suburbans and Provincials showed rising values; but the only actual change was a rise in Crystal Palace. All the Continentals commanded better prices; but, excepting a fractional variation in Imperial, their quotations were left standing. Of the rest, Monte Video Gas advanced ½. There was considerably more activity in Water, with a free rise in prices, especially of debenture stocks.

The daily operations were: The Gas Market was almost inanimate at the opening; and nothing moved. In Water, Lambeth and West Middlesex rose 2 each; and Lambeth debenture, 3. Business in Gas was better on Tuesday. South Metropolitan "B" rose 2; but Gaslight "A" fell 2. In Water, Lambeth and West Middlesex gained 1 each; and Lambeth 7½ per cent., 2. Wednesday's transactions were only moderate. Commercial debenture advanced 1½. Business became quieter again on Thursday; but prices were good. Gaslight "C," "D," and "E," improved 3; and Monte Video, ½. New River debenture rose 4½; and East London debenture and Lambeth debenture, 3 each. Friday was a little more active. Gaslight "A" fell 1; but ditto 6 per cent. debenture rose 7½. Business on Saturday was much as usual; but important advances in quotations occurred. Crystal Palace rose 3; Gaslight 4 per cent. debenture, 1; and South Metropolitan debenture, 3½.

ELECTRIC LIGHTING MEMORANDA.

A New Electric Lighting Company—The Financial Condition of the Electrical Trades—Electric Traction at the Tramways Institute—Electric Lighting at the Railway Congress.

AT last there is news of another electric lighting company being brought before the public; and the event is of sufficient rarity to call for notice on this account. When things are very scarce —like great auk's eggs—they have a certain notoriety for this reason alone, irrespective of their intrinsic value or interest. So it is now-a-days with new electric lighting companies. There was a time when these ventures were hatched out at the rate of two or three a week. But those days are gone, never to return. "There are no eggs in last year's nests," says the Spanish proverb. Therefore, when one hears of an announcement that the British public are again asked to put money into an electric lighting company, one wonders why the promoters are not content to do as electric lighting schemers generally have done for several years past—get their money out of the ratepayers. It appears, however, that the company in question—which by the title professes to be formed for the purpose of working a certain patent device stated to be admirably adapted for the lighting of towns and villages—aims at ultimately getting money out of a number of such places. We cannot honestly say we wish the company may get it. The whole scheme has been very soundly "slated" by the *Electrical Review;* and there is little prospect of any more being heard of it. But it is impossible not to see from this example how small a thing electric lighting speculation has become.

Talking about electric lighting speculation raises thoughts on the subject of the financial condition of the electrical trades generally, which are all in a bad way just now, at home and abroad. It is, indeed, reported of the electrical industries of America that, with few exceptions, they are in a desperate condition. The electric lighting and traction "booms" of the last decade are spent; and very few of the rotten companies formed with the object of introducing different systems into American cities are doing anything more than dragging out a miserable bankrupt existence. We on this side have often been requested to admire the marvellous quickness of the development of the electric lighting industry of America; but nothing was said about the ramshackle way in which the work was done. This is now producing the inevitable result; and as the bankrupt lighting companies cannot afford to renew their plant, electric lighting is going out of use again in many a shaky "city" where it flaunted for a season.

Electric traction was discussed in an academic style at the recent meeting of the Tramway Institute, with the net result of showing that no substantial progress can be signalized in the application of electricity to haulage of tramcars. Mr. Neale, of Birmingham, representing a company possessed of steam, horse, and electric cars, "and the finest cable-line yet laid down" declared his preference for the last-named system. The Company's accumulator cars have proved a very great loss; but Mr. Neale thought the system has a future before it—a very doubtful admission—provided that the weight of the batteries can be substantially reduced. With regard to the trolley-wire system (the only practical alternative to the accumulator car), experience shows that British municipalities have an invincible repugnance to the permanent disfigurement of their streets in this way, merely in order that tramcars may be driven thereby at a problematical saving upon the cost of horse haulage. Their attitude in this regard is a worthy one; and so long as our local authorities persist in it, there will be the less reason for owners of gas and water pipes in the subsoil to think further about electrolytic troubles.

If electric traction did not come off very well at the meeting of the Tramway Institute, electric lighting for trains fared even worse at the International Railway Congress recently held in London. One of the reports presented to this Congress was on the important subject of the lighting of trains; and it was the general opinion of the meeting that at present, for efficiency and economy, oil gas holds the field. The representatives of several railway companies described experiments with electric lighting. On the carriages of the Wagons-Lits Company accumulators have been tried; and also a dynamo in the guards' van, driven off the axle of the car. But the system has been given up on the score of expense. This seems a remarkable conclusion, inasmuch as the axle-driven dynamo might be supposed to get its motive power for nothing. After discussing incandescent gas-lamps and the prospects of acetylene—which the railway engineers seemed to be a little afraid of—the conclusion at last agreed upon was that the use of compressed gas of high illuminating power was the most satisfactory; but that in certain cases oil-lamps, and even candles, were found sufficient. Candles were put into the resolution by special desire of a Spanish railway representative; and it must be confessed that mention of them spoils the look of the conclusion. Curiously enough, there does not appear to have been a single speaker in the Congress to say a good word for the electric light, even when used in connection with a "penny-in-the-slot" apparatus. This was a very significant circumstance, seeing how much effort and money has been devoted to perfecting the electric lighting of railway trains. It has been understood that the system has worked satisfactorily upon a few English lines; but it certainly is not being extended.

A New Combination of Argon.—The *Comptes Rendus* contains an account, by M. Berthelot, of a new combination of argon. Following up his previous researches, the author has discovered, says *Nature*, that free nitrogen, prepared pure from nitrites, can be caused to enter into combination with the elements of carbon disulphide when subjected to the spark or silent discharge after saturation with disulphide vapour. The resulting compound contains some mercury sulphocyanide, and does not regenerate nitrogen under the action of heat or of concentrated sulphuric acid. When argon is employed in place of nitrogen, a similar reaction appears to take place. Under the continued action of the silent discharge, a sample of 6·55 cubic centimetres of argon, as pure as it could possibly be obtained, saturated with carbon disulphide vapour at 20° C., and confined in the reaction-tube by mercury, gave a continuous absorption which appeared to go on indefinitely. The product contained mercury, but gave no reaction for sulphocyanide. When heated, a quantity of gas was recovered equal to about one-half the volume absorbed; and this recovered gas was proved to be argon by condensation with benzene, and production of the remarkable fluorescence previously described. Though this work has been done on such small quantities of material that an exhaustive examination of the product was not possible, M. Berthelot believes that he has satisfactorily demonstrated the significant property of argon—that it can enter into combination, and be regenerated from its compound or compounds with its initial properties intact.

DIPS INTO THE PAST.—PROJECTS THAT FAILED.

The history of gas lighting, as of every other product of aggregated human activity and ingenuity, is a record of advances and reverses. The endeavours of inventors to improve the methods and widen the scope of the art, and the schemes of adventurers to extend its commercial application, have alike been marked by dire failures as well as by striking successes. There have not been wanting Cagliostros to scheme and dupe, as well as Arkwrights to plod and invent; and the present position of the industry is the outcome of the labours of the one in despite of, but not uninfluenced by, the designs of the other—the net result of the ebb and flow caused by their several activities. In discoursing of some of the more notable incidents that have chequered the past, we are not relating merely an idle tale. If it be helpful to the cause of progress in social and political affairs occasionally to review past events in the light of the present, or, conversely, to examine the problems of to-day by the experience of former times, the exercise must be productive of good in the conduct of a great and progressive industry.

At the outset, therefore, we would declare that our object is not merely the delectation of our readers. Our purpose will fail of its intended effect if the story we have to tell be not fruitful in suggestion, which, rightly applied, will also tend to their edification. For while the record of events that happened in bygone times must always be of interest to the earnest student, whether of mankind or of technics, it is only as the lessons they teach are helpful (either as guides or as warnings) to the cause of further progress, that they are of manifest importance to us. A great historian has said: "No past event has any intrinsic importance. The knowledge of it is valuable only as it leads us to form just calculations with respect to the future." It is because the knowledge of past failures may be of service as aids to future successes, or at least as finger-posts showing what to avoid in order to escape disaster—thus preventing the waste of much fruitless endeavour—that we have undertaken to discourse on projects that failed.

At the dawn of gas lighting, the two foremost pioneers of the new art were men of widely opposed characteristics and diverse genius. The annals of company-promotion might be searched in vain for a more daring enthusiast, more ambitious schemer, and, in many respects, more visionary dreamer, than Winsor. A harder-headed, more practical, or more ingenious worker than Murdoch has not often been seen. One trait only they had in common—firm faith in the ultimate commercial success and universal adoption of the new illuminant. In the case of Murdoch, it rested upon the surest foundation—sound practical experience, which he had obtained by patient experiment and plodding industry, and which he was content to increase by gradually, but surely, enlarging the sphere of its application. On the other hand, Winsor, on learning how to produce the novel result of "light from smoke," immediately forms, with the rash presumption born of ignorance, the most daring and unbounded scheme for its commercial exploitation. Destitute of the merest smattering of chemical knowledge, he has the temerity to ascribe the most wonderful qualities to gas and to the results of its combustion; while the process of its manufacture is made to appear a veritable mine of chemical products. Without having so much as lighted a good-sized building, he has the boldness to make forecasts and calculations referring to the utilization of gas on an enormous scale—calculations promising fabulous returns to every modest investor in the scheme. Indeed, he seems to have been so infatuated by the marvellous prospects which his active imagination saw through the smoke issuing from his "*patent light oven*," as actually to believe the extravagant fables he put forth. And, at this day, one knows not whether to be more amazed at the sublime rashness of the unlearned dreamer, who could form such extravagant conceptions, or the scepticism of some of the wisest contemporary men of science, who, like Wollaston and Sir Humphry Davy, could not admit the possibility of gas being practically applied as an illuminant on any large scale at all. To be sure, in thus complacently ignoring or overleaping the long interval of labour and invention that was inevitable before his crude ideas could be moulded into any sufficient practical shape, Winsor but resembled present-day apostles of the Mann-Tillett type, who preach a millennium of maximum wages for minimum work, without counting the steps by which it is to be attained.

It might have been thought that Winsor's harebrained project for producing results which are demonstrably absurd and irrational, was a sufficiently obvious monument of human folly to deter others from following in his footsteps. In point of fact, it was only the prelude to a long series of magniloquently announced schemes that have appeared, at irregular intervals, from his day down to the present. Among the most remarkable features in the annals of gas lighting are these projects, cropping up now and again, for revolutionizing the ordinary conditions of gas making—projects which the application of a little elementary science, or of practical experiment directed by a modicum of common sense, would have shown to be preposterous and futile. To take only one or two instances. There was the Photogenic Gas Company, launched in 1862, to carry out certain patented methods of naphthalizing common air, and distributing it instead of ordinary lighting gas. Practically the

same process had been patented years before; and, when it was tried in practice, it had proved an utter failure. This "photogenic light" was said to be "so pure, bright, and wholesome that the public ought to be willing to pay much more for it than for ordinary gas light, whereas it would be supplied at one-fourth the cost." It is needless to say that, except on paper, the general pubic never saw the "photogenic light." Yet so boldly were its pretensions advanced, that it was said no scheme had more alarmed the shareholders of gas companies. In the event, it was the shareholders in the new venture—which had been, at first, projected with a capital of £200,000, one-fourth of which was to be paid for the patents—who had real cause for alarm; the Company, at last, being wound up in 1869. There was also a Tan Gas and Charcoal Company launched, about the same time, "with every prospect of success." An assured profit of £11,700 was to be realized the first year, on a capital of £20,000. Instead, however, of paying a dividend of upwards of 50 per cent. on the capital, the whole of it was lost.

Schemes such as those we have mentioned could, however, only take in the unwary. More dangerous were those in which some really novel or truly scientific process was involved, which, yielding satisfactory results when carried out on an experimental scale or in a tentative way, required some experience under actual working conditions to reveal their weaknesses or shortcomings. Of this class, one of the most notable was that known as White's Hydrocarbon Gas Process, which created a great stir in the gas world during the fifties. Essentially, the process consisted in the introduction of water gas, along with excess of steam, into a heated retort in which coal or other carbonaceous material was being distilled. It was claimed that in this way the non-illuminating water gas was enriched with illuminating hydrocarbons through part of its hydrogen or carbonic oxide (or of both) entering into chemical combination with the carbon of the coal or other material being carbonized. At the same time, the hydrocarbons given off from the coal were protected, to some extent, from contact with the heated walls of the retort, and thereby from decomposition, through their dilution with the introduced gases and steam. Thus the invention was a praiseworthy attempt to embody a well-known property of gases, which has had an attraction for the foremost gas engineers from the time of Lowe down to the present day—the property, namely, which non-illuminating or poor illuminating gases of low density possess of taking up, and retaining in suspension or solution, illuminating hydrocarbons of higher density. It also recognized and endeavoured to reduce the hurtful effect on the luminiferous hydrocarbons of contact with red-hot surfaces in the retort.

White's process was duly investigated and reported upon by perhaps the ablest chemist (Frankland) and the foremost gas engineer (Clegg) of the day. Both these eminent authorities showed that a higher value in illuminating gas was obtained from a ton of coals by this method than by the ordinary mode of manufacture. Frankland regarded the principle established by the experiments as one of great importance. He believed that the advantage of the process consisted in "the washing out of the luminiferous hydrocarbons, generated in the coal retort, by the stream of water gas, which latter shortened the period of contact of the former with the heated sides and contents of the retort, and to that extent prevented their destruction." He clearly recognized, however, a principal weakness of the process, wherein, in fact, it chiefly failed of its promises—namely, that the action of the steam and water gas within the coal retort was not confined to the residual carbon therein; but that the hydrocarbons being evolved from the coal were attacked by them. Thus, water gas, containing a high percentage of hydrogen, was being produced at the expense of destroying more valuable compounds. By analysis, he found that the gas produced by White's process contained less marsh gas and more hydrogen and carbonic oxide than that produced by the ordinary method. At the time these experiments were carried out, the opinion was general that hydrogen was the most serviceable diluent for the rich hydrocarbons in coal gas. It was this mistaken notion as to the value of hydrogen which led the younger Clegg to form a high opinion of White's gas, while (unlike his father) clearly recognizing and making known his misgivings as to the new process of manufacture being made a practical success. Thus he wrote: "A perfect illuminating gas is that which consists of light-giving hydrocarbons with pure hydrogen as a diluent. The hydrocarbon process approaches the nearest to this *in theory*." In our time, we have learned, through the researches of Dr. Percy Frankland and Mr. Lewis T. Wright, that the most valuable constituent of coal gas, apart from its condensable hydrocarbons, is marsh gas.

So much confidence was established in White's process, that installations on a fairly extensive scale were carried out in several places; but when it came to be tried in large gas-works by ordinary workmen, and subject to every-day conditions, many drawbacks to its advantages and hindrances to its success were revealed. Chief among these were the irregular yield of water gas, and consequent impossibility to maintain a product of regular quality—the high percentage of carbonic acid contained in the gas necessitating the employment of special means of purification, unless a great sacrifice of illuminating power were made; and, last but not least, increased wear and tear of the retorts, which had to be of iron, as clay ones were too porous for the water gas. The iron was rapidly oxidized by the action of the steam upon it at a bright red heat. The retorts speedily cracked by exposure to sudden alternations of temperature; and the steam, oxidizing the iron, tended continually to widen the fissures. In the end, after two or three years' experience of the practical application of the process, the Hydrocarbon Gas Company collapsed, as so many similar ventures have done before and since. It is sad to relate that its ingenious promoter, who deserved a better fate, died some few years later, if not actually destitute, in very straitened circumstances.

Though White's process was thus, in practice, a lamentable failure, it may not be said to have existed in vain. Who can tell the hidden germs of instruction, the springs of inspiration, or the incitements to further endeavour that lie in so-called failures? Or who knows the steps by which any notable invention has been evolved, or any practical perfection in the arts attained? It is a far cry from Stephen White to William Young. Yet do we see in the process, faulty as it undoubtedly was, devised by the former, the first rude attempts to apply a principle in gas making of which it has been left to the latter to discover the true bearings, and carry to practical perfection. It is a most interesting fact that Frankland deduced, from his experiments on the reactions going on in White's retort, that the best source of water gas would be water and coal tar alone; and it has been left for another generation of gas makers to behold the theoretical deduction converted into accomplished fact in the latest product of Young's genius. Thus one delves, another lays the foundation, and others build thereon, until the master builder brings forth the head stone with rejoicings, and crowns the edifice.

(To be continued.)

GROVES AND THORP'S "CHEMICAL TECHNOLOGY."

SECOND NOTICE.

IN our first notice of the second volume of Groves and Thorp's "Chemical Technology," which bears the title "Lighting," we confined ourselves to the editorial portions of this instructive work; and we now propose to deal with the productions of the sectional authors. The first place is given to Mr. W. Y. Dent's chapter on Fats and Oils, which extends to 45 pages of the book, and like all the rest of the matter is illustrated, although not so freely as some of the other articles. Mr. Dent tells his readers what fats, oils, and waxes are, how they are obtained, and the treatment which they receive to prepare them for illuminating purposes. Mr. John M'Arthur follows with a section devoted to Stearine—an industry originated by the chemical researches of Chevreul, and consequently severely scientific in all its processes and developments. Neither of these sections calls for detailed comment here. The third section, on Candle Manufacture, brings the student nearer to the actual production of light. It is an important contribution, bearing the well-known names L. and F. A. Field. These authorities on the subject commence at the beginning, telling the reader that "the invention of candles may be regarded as contemporaneous with the need of artificial, portable means of lighting." They define a candle as "a porous, combustible core, surrounded or merely saturated with a fusible, inflammable solid. Accepting this definition, the man who first selected a more than ordinarily resinous brand to serve as a torch to lighten up the darkness, was the primeval chandler." It would be easy to pick holes in this picturesque claim for the extreme antiquity of the chandler. Inasmuch as the meaning of the word is a maker of candles, it must follow that the candle, properly so called, is a manufactured article, and therefore as different from the brand snatched from the burning as a sword is from a torn-off branch. It might be more plausibly argued that the step from the burning resinous stick to the rudest candle, prepared with a definite purpose, must have marked an epoch in the history of civilization; for social man thereby equipped himself with the most potent of all agencies for dispelling, not only natural darkness, but also the gloom and isolation of barbarism.

The authors attempt to give the history of the development of the candle in chronological order; starting with the torch and the link, which found their ultimate possibility of utility and ornament in the flambeau. The word candle is derived by the authors from the Latin *candela*, from *candeo*, I shine—a growth from the Sanscrit root *kan*, which had endless possibilities hidden in it. It is stated, somewhat arbitrarily, that the employment of candles as a means of lighting did not become general before the commencement of the seventeenth century; but the familiar legend which attributes to King Alfred the use of candles as time-measurers, surely argues for a much more ancient familiarity with the use of the article for its more direct purpose. It is a curious illustration of the slowness of real improvement that plaited wicks were only introduced so recently as 1820. Meanwhile, we are told that over fifty patents for snuffing candles mechanically were taken out, some of them marvels of ingenuity. The authors devote particular attention to the subject of the wick, which they justly term "the soul of the candle; for on the proportion, preparation, and condition of this slender core, the candle depends for the proper discharge of its functions." Photometrists will not dispute the force of this remark. The plaiting of the wick was

the fundamental discovery which rendered it possible to burn candles regularly; but a great deal more than plaiting goes to the preparation of a really good wick. The raw material must be selected with extreme care; and after the wick is made, it requires to be "pickled" with a view to the material of which the candle is to be composed.

It is a question to which we have never succeeded in obtaining a conclusive answer, why the French equivalent of our word candle is not *chandelle*, as would be naturally supposed, but *bougie*. Now "bougie," in the Messrs. Field's vocabulary, means the flexible form of drawn candle made up in a coil, somewhat like a ball of string, and still sparingly employed by users of sealing-wax, and otherwise when the light is only required for a short time. This article has no relation to what is known in France by the same name, although the word is a French one. The discrepancy illustrates how pitfalls lurk in the way of the free-and-easy translator of one language into another who proceeds upon the principle of representing a foreign word by its apparently natural equivalent in his own language. Strangely enough, the manufacture and use of candles as standards of light is not mentioned by Messrs. Field; and this omission cannot be regarded otherwise than as a blot upon their work. There is not much "trade" in this description of candle; but in view of the attempts that have been made by the London Gas Referees to import scientific accuracy into their manufacture, some notice of this branch of the manufacture of candles was to have been expected in an authoritative text-book of the industry.

After candles, petroleum. Mr. Boverton Redwood's account of the Petroleum Industry is one of the most valuable sections of this work; being only excelled in interest, perhaps, by the same author's careful monograph on Lamps. Mr. Redwood goes back to Herodotus for his earliest descriptive reference to petroleum; and he only quits the subject with the statement that what has already become an immense industry which supplies the whole world with a necessary of life, is "still in its adolescence." He thinks that the present and immediate future might justly be recognized in history as "the age of petroleum." This view is at any rate a welcome change from the other classifications of the same period, with which the world is more familiar in popular writings.

The earliest recorded uses of petroleum were medicinal; and the first known natural gas springs were employed for sacerdotal purposes. The modern petroleum industry dates, for all practical purposes, to the drilling of the celebrated Drake well in Pennsylvania, in 1859. "From this date, coal-oil refiners began to substitute crude petroleum for bituminous coal; and the distillation of the latter material for oil soon ceased to be profitable." The chief event of recent years in the history of the petroleum industry of the United States has been the remarkable development of the Ohio oil-fields. This oil, Mr. Redwood remarks, "contains sulphur compounds which are extremely difficult of removal; and it is therefore not a satisfactory source of kerosene, but it appears to be well adapted for use as liquid fuel, and is very largely employed for that purpose." It is also answerable in a great measure for the recent expansion of the carburetted water gas industry. American natural gas is very briefly mentioned by Mr. Redwood. He records the fact of the first gas well having been drilled at Fredonia, in the State of New York, in 1821; and states that for many years past systematic drilling for gas has taken place, and immense quantities of it employed as fuel. "The natural gas companies have, however, found it impossible to obtain adequate supplies; and many manufacturers have had to revert to the use of other fuel." What has been the benefit to the United States of this wondrous gift of Nature?

The locations of petroleum are given by Mr. Redwood, who also discusses its origin, physical characteristics, and chemistry. He remarks that petroleum is usually considered to have been formed by the slow decomposition of vegetable or animal matter, either in the rocks in which it is found, or in underlying strata. He notices the Berthelot and Mendeléeff theories of its formation; and cites Professor Peckham's arguments in support of the general view of the matter. The information here given respecting the characters and components of different petroleums, is very complete; and the process of winning the oil is fully described and abundantly illustrated. Boring for oil was a modification of sinking for brine; but the vast amount of ingenuity that has been applied to the boring and subsequent treatment of oil-wells, makes very interesting reading, as soberly and quietly recounted by the author. How exhaustively Mr. Redwood discourses of the qualities and uses of petroleum and its derivatives, may be appreciated from the circumstance that, in treating of paraffin and its applications, he does not omit to mention the Joly photometer blocks, which he says he has himself used with very good results.

The utilization of mineral oil for gas making does not appear to have come within Mr. Redwood's province. Yet at the close of a chapter upon the "cracking" of heavy oils into liquid hydrocarbons of lower specific gravity, he digresses into an account of the Dvorkovitz process. It is difficult to trace the logic of this incursion into a neighbouring technic; because there is no more "cracking" in the Dvorkovitz process than there is in other methods of producing illuminating gas from oil. As to "cracking," the reader interested in the subject may learn all about it from Mr. Redwood, who describes the process as consisting essentially in heating oil vapours above their boiling-point under pressure. In 1889, Dewar and Redwood patented a process and apparatus, described here, to enable intermediate and heavy oils to be readily converted, to a considerable extent, into lighter oils suitable for use in ordinary mineral oil lamps; "and even mineral spirit of low boiling-point, capable of being employed for the carburetting of coal gas, may be produced." We believe the late Mr. Frank W. Clark did something in this line; but Mr. Redwood does not mention his name. It may be remarked here that the term "cracking," as ordinarily used by gas engineers and chemists to signify the changes wrought in oil vapour by exposure to radiant heat or in passing through a "fixing" chamber or retort, does not refer to the combination of high pressure with this external heating.

Mr. Redwood's work on mineral oil ends with a full and particular description of the shale-oil industry, in which gas engineers are specially interested, as all the manufacturing processes are capable of being described as reversals of their own carbonizing devices. Where the coal gas manufacturer desires gas, the shale distiller seeks a fluid; and one of the most valuable of the residuals of both operations is the same commodity, sulphate of ammonia. Mr. Redwood, comparing the shale oil with the petroleum industry, observes that "the object of the shale-oil refiner is, like that of the petroleum refiner, to obtain by the classification of the hydrocarbons present, the largest yield of the products for which he has the best sale." Singularly enough, the aim of the coal gas manufacturer is identical with this! In taking leave of his subject, the author observes that "vast as is the consumption of mineral oil in lamps, and of paraffin in the form of candles, the manufacture of products suitable for use as lubricants also constitutes a business of immense industrial importance; whilst the growing employment of petroleum as liquid fuel and as a source of gas for illuminating purposes, opens up a field of incalculable magnitude." All this is quite true, as also is the author's opinion that the petroleum industry has not yet attained its full growth. In another article we shall deal with the section on Lamps.

NOTES.

The Strength of Tie-Bars with Screwed Ends.

A question has been raised by Mr. J. H. Edwards, in a letter to the *Engineering Record*, which it would be of advantage to designers of structural ironwork to have answered in one sense or the other. It refers to the strength of tie-rods formed with plain screwed or with thickened ends. According to the 1886 edition of Trautwine's "Pocket-Book," there is no difference in the ultimate resistance of a long tie-rod to a slowly applied strain, whether its screwed ends are upset, or swelled, or not. Mr. Edwards states that he has communicated with Mr. J. C. Trautwine, junr., and asked him whether this is the interpretation that should be put upon the remark in the "Pocket-Book." In reply, Mr. Trautwine repeated the assertion, originally due to his father, that a *long* rod may be expected to break about mid-length under the same slowly-applied pull, whether the thread at the end is cut into the original diameter of the bar (thus reducing the diameter) or whether the screwed ends are first upset, so that the diameter inside the thread is not less than that of the original bar. Mr. Trautwine states that he has not learned that this remark is erroneous; and he has always explained to himself the apparent paradox by the theory that under a slowly-applied load a long bar, before breaking, will stretch sufficiently to reduce its diameter in the middle of its length below the thickness left by the cutting of the thread in the original bar. Additional information is desired on the subject from engineers who have made tests of such rods, and observed them under actual use. The circumstance of upset ends being a universal requirement in respect of tie-bars, although lending general support to the idea of their desirability, is not absolute proof of necessity.

The Visibility of Lights at a Distance.

It is on record that in 1890 the German Marine Observatory tested about 3000 running lights as used on board ship, and found two-thirds of them defective. Further tests of the visibility at a distance of lights of known candle power were made last year by a German Government Committee; and, curiously enough, the first public intimation of their results has appeared in a leaflet just issued to seamen by the United States Weather Bureau. The law of emission for a white light is that its visibility is proportional to the square root of its candle power; and the results of the German experiments closely follow this law—the departures from it being no greater than the estimated errors of position of the vessel carrying the light. The mean of a large number of observations gave, as the distance to which a white light of 1-candle power became visible, 1·4 miles for a dark clear night, and one mile for a rainy one. Experiments carried out in America after the International Maritime Congress in 1889 gave the following results for very clear weather: A light of 1-candle power was plainly visible at one nautical mile, and a light of 3-candle power at two miles. A 10-candle power light was visible with an ordinary binocular at four miles; one of 29 candles, faintly at five; and a light of 33 candles, visible without difficulty at the same distance. On

another exceptionally clear evening, a white light of 3·2-candle power could readily be distinguished at three miles; a light of 5·6-candle power, at four miles; and one of 17·2-candle power, at five miles. The Dutch Governmental experiments, conducted at Amsterdam, gave the following results: A white light of 1-candle power, visible at one nautical mile; 3·5-candle power, at two miles; and 16-candle power, at five miles. Experiments with green lights gave 0·80 mile as the range of visibility of 1-candle power. The illuminating power of a green light to be visible at one, two, three, and four miles was respectively 2, 15, 51, and 106 candles. The remarkably rapid diminution of the visibility of green light with distance, even in good weather for observations, and the still more rapid decrease in rainy weather of a character which but slightly affects the visibility of white light, show that it is of the utmost importance to select for the glass a tint of the colour which will interfere with the intensity of the light as little as possible. The tint recommended is a clear blue-green. Yellow-green and grass-green become indistinguishable from white at a short distance. For the red a considerably wider range of tint is admissible; but a coppery-red is found to be the best.

The Bacteriological Testing of Water.

A highly interesting and important paper on "Bacteria and other Organisms in Water," by John W. Hill, with the discussion, appears in the May number of the "Transactions" of the American Society of Civil Engineers. The main purpose of the paper is to elucidate the value and meaning of the bacteriological examination of drinking water, with special reference to the case of town supplies which have been, and must continue to be, subject to previous sewage contamination, The author was moved to take up this subject from a desire to know something about the micro-organisms in the Ohio river water supplied to the city of Cincinnati. He appears to have succeeded in this part of his inquiry, for he describes a large and varied collection of foreign constituents, living and otherwise, found in the samples of water examined. The next question that arose in this connection was as to the possibility of purifying such water by filtration. Mr. Hill recognizes the truth that it is not possible to reject water containing sewage pollution in all cases of a public supply; but he holds that it is practicable to sterilize all such waters before they are used for dietetic purposes. The work of Professor Percy F. Frankland upon the water supply of London is cited; and the conclusions of the Royal Commission are also duly referred to. Mr. Hill is of opinion that the results of bacteriological tests are to be regarded rather as indications than as proofs, because of the uncertainty still obtaining as to the quality of the various kinds of bacilli or bacteria found to be present. A striking portion of his paper deals with the example of a widely-advertised and much-consumed natural table water sold throughout the civilised world at a high price. The result of an examination of a bottle of this water showed, in three plate cultivations, the presence of from 1984 to 2112 bacteria per cubic centimetre; the standard for the London water supply being 100 bacteria per cubic centimetre; and the number in practice being often as low as 18 to 20 bacteria.

Freezing a Bed of Quicksand.—A novel engineering scheme in the construction of the foundation of the retaining wall of the new speedway at High Bridge, in New York City, is the freezing of a bed of quicksand which impeded the work. A row of 4-inch pipes have been sunk a few feet apart, to the depth of 40 feet. These pipes are capped at the bottom, and inside them are inserted smaller pipes, open at the bottom. Cold air is forced from a condenser through the smaller pipes into the larger, and thence returned to the condenser. The air is cooled by expansion to a temperature of about −45° C., thus freezing the surrounding mud and wet sand, and checking the flow into the excavation.

Uniform Methods of Testing Materials of Construction.—A conference on this subject is to be held at Zurich on the 9th, 10th, and 11th of September next. It has been inaugurated by the International Association for the Unification of Methods of Testing Materials, founded by the late Professor Bauschinger, of Munich. It is proposed to promote these ends by (1) personal intercourse between technical men of all countries; by (2) the interchange of views and experience by means of addresses and papers; by (3) reports of important points in experimental researches on the chemical and physical properties of materials of construction; and by (4) reports on the practical durability of materials under exceptional conditions and circumstances.

Iron and Steel Institute.—The autumn meeting of the Institute is to be held in Birmingham from the 20th to the 23rd prox. The programme will embrace visits to the leading industrial establishments in and around the city. The Mayor will hold a reception, at the Council House and Art Gallery, on the evening of the 20th. Among the papers expected to be read are the following: "The Thermo-Chemistry of the Bessemer Process," by Professor W. N. Hartley, F.R.S.; "The Hardening of Steel," by Mr. H. M. Howe; "The Mineral Resources of South Staffordshire," by Mr. H. W. Hughes; "On Tests of Cast Iron," by Messrs. W. J. Keep and T. D. West; "Estimating Oxide of Iron in Steel," by Mr. A. E. Tucker; and "The Use of Nickel in the Metallurgy of Iron," by Mr. H. A. Wiggin.

TECHNICAL RECORD.

THE CHEMICAL CONSTITUTION OF GAS ENRICHERS, AND ITS RELATION TO THEIR ENRICHING VALUE.

By Wilfrid Irwin, F.C.S.

[A Paper read before the Manchester Section of the Society of Chemical Industry, and Reproduced from the Society's "Journal."]

So very much has been written of late on the theory of luminous combustion, and the influence of the various components of a gas on its illuminating power, that it may seem presumptuous for a comparative stranger to enter a field where so many chemists of standing and ability are already engaged, and are daily making new additions to our knowledge on the subject; for, though it is now nearly a hundred years since the manufacture of gas for lighting purposes was first introduced on a commercial scale, it is only very recently that any scientific knowledge of the cause of luminosity has been forthcoming. The widespread ignorance of the composition of illuminating gas may be gleaned from the fact that in very few of even the later text-books is any mention made of its most important illuminant, benzene—a substance which is now being manufactured on an enormous scale. Its history may be found in Lunge's treatise on "Coal Tar and Ammonia" (1887), p. 114, and in Roscoe and Schorlemmer's treatise on "Organic Chemistry," Vol. III. (1886), p. 64.

In the year 1882, the price of 90 per cent. benzol having risen to 15s. per gallon, Mr. Josiah Hardman suggested to me the advisability of experimenting on this process. A few trials soon showed me the right course to pursue; and the results were truly startling. I found that as much as 3½ gallons of benzene could be produced from 10 000 cubic feet of Manchester gas; or, in other words, of all the benzene formed in the process of coal carbonization, only from 3 to 5 per cent. remains in the tar—the rest going forward into the gas, and supplying a great part of its illuminating power.

Plant was immediately erected, and within a very short time several hundred gallons were actually extracted from the Corporation gas; the residue being employed as fuel. Large carbonizing works were also soon in course of construction; and the commercial bearing of the case may be gauged from the fact that at that time 1 ton of coal, costing 6s., with labour (say) 4s., would produce 30s. worth of benzene, in addition to other bye-products.

There occurred to me about this time an idea to make an arrangement with gas companies for the extraction of benzene from their gas, and to replace the illuminating power lost thereby with light petroleum spirit; the former being about eight times the price of the latter. I soon found, however, that at least three times the amount of spirit was required to repair the loss of a certain quantity of benzene, and that there was also great difficulty in getting the required amount into the gas without condensation. These facts, combined with the rapidly-falling price of benzene, soon rendered the suggestion quite impracticable. Mr. G. E. Davis afterwards brought out a process in which he cooled the gas before absorption; and Mr. S. Mellor, one for obtaining the benzene by compression. So that Manchester and benzene are somewhat intimately associated.

In the years succeeding, from the small beginning above mentioned (largely owing to the increase in the number of coke-ovens of the Simon-Carvès type, especially in Germany), the supply of benzene has outstripped the demand. The price now [May 24] stands at 1s. a gallon; and unless some new requirement can be found for it, it appears likely to remain there. It was in connection with experiments on its efficiency as a gas enricher that I was led to take up the line of investigation I am about to describe.

Methods Employed for Conducting Experiments on Gas Enriching.

This, to begin with, is no easy matter, as the contact of ordinary coal gas with water was found to cause a rapid diminution in illuminating power, so that known mixtures in ordinary gas-holders could not be obtained. An experiment will illustrate this. Take a large bottle half-filled with water and the remainder with Manchester gas of 19 to 20 candle power. Agitate the two together, and then test the gas again. It will be found to have fallen from 19 candles to 1 candle with a union-jet burner, or to 2 candles with an Argand.

This fact could only be due to the solubility in water of the benzene and olefines; and as the former is described in the text-books as practically insoluble in water, I determined to settle the matter by experiment. The result was just what one would expect, and was as follows: 1000 volumes of water dissolve 1·45 volumes of benzene.

As a little digression, I resolved to compare it with toluene and xylene in this respect. You may be aware of the fact that the addition of CH_3 in the aromatic nucleus decreases the solubility. Thus aniline is more soluble than toluidine. Phenol is more soluble than cresol, and this again than xylenol; and it appeared interesting to discover if the base of all these bodies followed the same law. This was found to be the case. As I said before, 1000 parts of water dissolve 1·45 parts of benzene, 0·57 part of toluene, and 0·12 part of xylene. In comparison with the foregoing, heptane was found practically insoluble in water.

The method I adopted for the regular and gradual absorption by the gas of an enricher on a laboratory scale was the following: The gas, after being well dried with chloride of calcium, was passed over the enricher—say, pure benzene; and a bye-pass was arranged for the unenriched gas to meet and mix with the enriched gas before passing to the burner for testing. By this means, only substances with constant boiling-points could be tested; but it appeared the most satisfactory method I could think of for the work I wished to perform.

The first experiments I propose to describe were made with disillumined coal gas—that is, gas from which all illuminating power had been extracted by treatment with fuming sulphuric acid. Such gas, with a union-jet burner, tested about 0·03 candle; with an Argand burner, 0·75 candle. With an Argand burner having its air supply checked, it gives a flame of about 5 candles, but difficult to determine, owing to its peculiar colour and great length. The gas is practically a mixture of 2 of H to 1 of CH_4. As the union-jet burner is the commonest in practical use, all my experiments, except a few specially mentioned, have been made with it; a No. 4 Bray being the one chosen.

Note very carefully the flame we get with this disillumined gas. Next to the jet is a space quite devoid of luminosity; above it, a very slight luminous band; higher up still there is a perfectly dark band; and, lastly, at the very top of the flame is again a fringe of slight luminosity.

To determine the meaning of this, I made the following experiments: I first introduced into the disillumined gas a small quantity of benzene vapour, and noted the change in the flame. I found that the lower slightly luminous portion greatly increased in brilliancy; the result being a comparatively small but very bright flame. I next tried benzene with hydrogen and water gas respectively, and found that the combination in both cases gave a result similar to, but more intensified than, that when disillumined coal gas was employed.

I then tried the effect of hexane—an enricher which contains a large percentage of hydrogen, and which, on decomposition in the lower part of the flame, would yield a considerable amount of CH_4. The result of this admixture was that the lower part of the flame was not rendered anything like so brilliant as with benzene, but that the outer luminous fringe was considerably increased in size, so that a large, though not highly luminous, flame was the result. The union jet was now replaced by an Argand burner, which doubled the illuminating power of the hexane gas, while the gas enriched with benzene was not greatly altered—say. about 20 per cent.

Professor Lewes's researches seem to point to the fact that most substances which produce luminosity in gas do so by first of all decomposing into C_2H_2 and H; and, further, that the endothermic heat of decomposition of C_2H_2 causes a rapid rise in the temperature of the liberated carbon, resulting in the luminosity with which the flame is endowed. When hydrocarbons of the paraffin series are passed through a red-hot tube, a large amount of C_6H_6 and CH_4 is produced; the latter being further decomposed by more intense heat into C_2H_2 and H. A less intense heat is required for decomposition of benzene, which, however, also produces large quantities of C_2H_2.

The meaning of the stratification of slightly luminous flames now became clear. When the gas first leaves the jet, it passes through the "baking" part of the flame, where bodies such as C_6H_6 and C_2H_2 are decomposed and form the lower luminous band. In the case of gas treated with sulphuric acid, a trace of C_6H_6 has evidently escaped absorption. As we pass farther up the flame, the temperature naturally rises, until after passing the non-luminous layer, where complete combustion of the liberated carbon has taken place, we ultimately reach a point sufficiently high in temperature to decompose CH_4 with the production of C_2H_2, the decomposition of which again yields the luminous fringe at the top of the flame.

With an Argand burner, the heat of the whole flame is greatly increased. This has little effect on the benzene, as in a union jet there is still sufficient to cause its decomposition into C_2H_2. But with a body like hexane, which on decomposition would yield a large quantity of CH_4, the heat of the Argand is most beneficial, as it causes more CH_4 to decompose into C_2H_2 and H; and therefore very much less has to be spent in merely maintaining the heat of the flame by combustion. I have little doubt that this is the process which goes on in every gas-flame, with certain exceptions, to which I will refer later on.

We now come to the figures relating to the action of different quantities of benzene on disillumined gas; and as an example of the details required in each case, I will give the following: Volume of gas employed, 14 litres; volume of gas after the addition of benzene vapour, 14·28 litres; weight of benzene absorbed, 1·267 grammes; time occupied in burning, 7·5 minutes; candles burning at the rate of 119 grammes per hour; candle power calculated to 5 cubic feet per hour, 20·2 candles; benzene contained in a litre of gas burned, 0·088 gramme; benzene required per candle, 0·00434 gramme per litre.

The results of the disillumined gas *plus* benzene were—

0·0221	gramme per litre	gave	1·3 candles.
0·0385	,,	,,	4·1 ,,
0·0544	,,	,,	7·6 ,,
0·0630	,,	,,	9·6 ,,
0·0863	,,	,,	21·0 ,,
0·0881	,,	,,	20·2 ,,
0·1230	,,	,,	30·0 ,,

From the above it will be seen that 0·018 gramme per litre is required before any effect is produced on the illuminating power of the gas; but that after this point is reached, the illuminating power is increased at an average rate of 0·0034 gramme of benzene per candle, or about 4 candles per gallon per 10,000 cubic feet.

With the foregoing I carefully compared the action of heptane (prepared by fractionating petroleum spirit) on the disillumined gas. The following were the results:—

0·0528	gramme per litre	gave	2·15 candles.
0·1010	,,	,,	6·35 ,,
0·1560	,,	,,	11·10 ,,

From the above it will be seen that 0·028 gramme per litre was required before any illuminating action could be produced; but that, after reaching this point, the increase was at the rate of 0·0115 gramme per candle per litre, or about 1 candle per gallon per 10,000 cubic feet.

By comparing these results, I came to the conclusion that the carbon density alone had little to do with the enriching value of the hydrocarbon, but that it was the proportionate amount of carbon and hydrogen in the molecule that was the principal factor in determining its value. I therefore resolved to try the effect of toluol, which (if this theory, which I have since found that Knublauch was the first to put forward, be correct) should be below benzene in its illuminating value:—

Benzene.	Toluene.	Xylene.	Naphthalene.	Heptane.
C_6H_6 ..	C_7H_8 ..	C_8H_{10} ..	$C_{10}H_8$ ..	C_7H_{16}

With toluene I found 0·0033 gramme per litre was required per candle, against benzene 0·0034 gramme, and heptane 0·0115 gramme. This result did not seem encouraging; so I tried xylene, with which I found 0·0027 gramme per litre was required per candle.

This result quite upset the before-mentioned theory; and I began to conclude that the arrangement of atoms in the molecule might have a considerable influence on the enriching power of the hydrocarbons. I therefore tried the effect of naphthalene, and found that 0·062 gramme per litre gave 26·9 candles; 0·059 gramme, 23·5 candles; 0·046 gramme, 21 candles. The average, 0·058 gramme per litre, gave 23·8 candles. After allowing 0·010 gramme for the start, the amount of naphthalene required per candle per litre was only 0·0020 gramme; showing that its enriching power was more than half as great again as that of benzene, and nearly six times that of heptane.

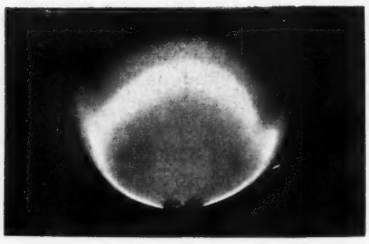
On comparing benzene with naphthalene, as regards structural arrangement, we find that, in the case of benzene, 92 per cent. consists of carbon combined with hydrogen; while in the case of naphthalene, 75 per cent. consists of carbon combined with hydrogen, and 18 per cent. of carbon uncombined with hydrogen. From this we may conclude that carbon, in combination only with other carbon atoms, and not linked with hydrogen, is of much greater utility as an enricher than carbon in combination with hydrogen. In other words, far more of the latter gets destroyed—*i.e.*, burnt—before the final decomposition of C_2H_2 takes place. As a matter of fact, it is very improbable that the two carbon atoms uncombined with hydrogen ever form C_2H_2 at all, but simply separate into free carbon.

From the above figures, we may calculate that carbon in combination with other carbon atoms only is nearly three times as efficacious as carbon in combination with hydrogen. In other words, only one-third of the carbon atoms in combination with hydrogen ever get utilized. So that, even in naphthalene, not more than 44 per cent. of the weight added to the gas is really utilized in emitting light; and since the addition of 0·002 gramme per litre raises the illuminating power of the gas by one candle, the amount of solid carbon engaged in emitting this quantity of light would be 0·00088 gramme; or, in other words, a gas burning for one hour, and giving a light equal to 20 candles, does not employ more than the extraordinarily small amount of 2·58 grammes ($\frac{1}{11}$ oz.) of solid carbon actually engaged in emitting light. Experiments on naphthalene and hydrogen, shortly to be described, confirm this result.

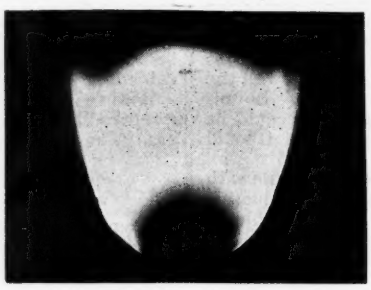
From the above considerations, and bearing in mind that, with a union jet, CH_4 and C_2H_6 are non-luminous, we arrive at the following four conclusions: That, in an enricher, a carbon atom combined with H_4 or H_3 is useless; that a carbon atom combined with H_2 possesses enriching power; that a carbon atom combined with H_1 possesses two or three times the enriching power of the foregoing; and that a carbon atom combined only with other carbon atoms again possesses two or three times the enriching power of a carbon atom combined with H_1. These facts easily account for the position toluene and xylene hold with regard to their enriching value.

My next experiment was on the influence of a body possessing a higher percentage than naphthalene of carbon atoms combined only with other carbon atoms. For this I used phenanthrene. Here again I obtained higher values than with naphthalene. But its very high boiling-point (350° C.) made it difficult to work with; and my results not being at all constant, I do not care to give them.

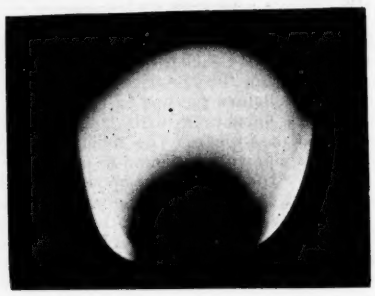
I then tried the effect of an oxygen atom in combination with benzene. For this I used phenol (C_6H_5OH)—the results being interesting: 0·020 gramme per litre gave 1·6 candles; 0·0841 gramme per litre, 11·6 candles, or 0·0064 gramme per candle after the start. This was nearly double the benzene figure; and it illustrates the deleterious effect of combined oxygen on the illuminating value of the enricher.



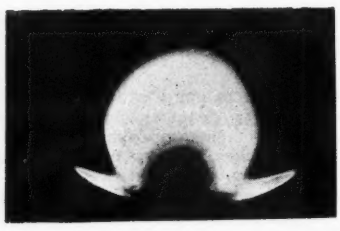
DISILLUMINED GAS.
OWING TO THE QUIVERING OF THE FLAME, THE BLACK BAND OVER THE LOWER LUMINOUS LAYER IS NOT VERY DISTINCT.



DISILLUMINED GAS AND BENZENE, SHOWING CONTRACTED SIZE OF THE NON-LUMINOUS PART OF THE FLAME.



DISILLUMINED GAS AND HEPTANE.



WATER GAS AND BEZENE.

WATER GAS, BENZENE, AND A LITTLE PENTANE.

WATER GAS, BENZENE, AND MORE PENTANE.

So much for the action of enrichers on disillumined coal gas. Let us now consider their action on hydrogen itself.

Benzene and Hydrogen.—0·068 gramme per litre gave 0·45 candle; 0·096 gramme per litre, 10·05 candles. Hence one candle, after the start, required 0·0028 gramme of benzene.

Hexane and Hydrogen.—0·121 gramme per litre gave only 0·2 candle, though this amount was increased to 1·5 candles with an Argand burner.

Naphthalene and Hydrogen.—0·0517 gramme per litre gave 4·3 candles; 0·0872 gramme per litre, 18 candles. Therefore 0·0355 gramme per litre gave 13·7 candles after the start, or 0·0026 gramme per candle per litre.

Mr. Lewis T. Wright, in a paper recently published,* lays great stress on the relation between the total effective carbon vapour (*i.e.*, carbon in combination with hydrogen) in any gas and its illuminating power. I would beg to bring before his notice the case of this mixed gas and that of disillumined coal gas. The latter, with a carbon density of 30 per cent., has an illuminating power of at most 5 candles with an Argand burner (air checked). Naphthalene *plus* hydrogen with a carbon density of 7·5 per cent. has an illuminating power of 18 candles. This fact, you will see, quite disposes of the theory advanced by some, that a good heating gas and a good lighting gas are practically synonymous terms.

In the foregoing figures, there is one point that needs some explanation. In the case of benzene 0·065 gramme, with hexane 0·12 gramme, and with naphthalene 0·042 gramme per litre is required to be sacrificed before any luminosity is forthcoming. Professor Lewes finds the same to be the case with acetylene. He explains it by the fact that the more dilute is the enricher, the higher the temperature required for decomposition; and he assumes that it is the heat of combustion of a certain amount of the enricher that is required, in addition to that supplied by the burning hydrogen, for the decomposition of a further supply of the enricher—say, C_2H_2.

Additional proof appears to me necessary, however, to settle this point; for only half the amount of benzene (which has the same percentage composition of carbon and hydrogen as C_2H_2) is required, and only one-third the amount of naphthalene, to produce the same result, and this in spite of the high endothermic property of acetylene.

Again, in a disillumined coal-gas flame, where the percentage of carbon is far higher than in any of the above mixtures, a certain amount of benzene is required to be added before any perceptible addition to the illuminating power is obtained.

The only attempt at an explanation that I can give is to suppose that it is merely a question of the ability of a certain amount of the enricher to resist oxidation in the lower part of the flame before it can reach that portion of it which is hot enough to cause complete decomposition, with separation of solid carbon. Of course, the latter action will be hastened by the heat of combustion of that portion of the hydrocarbons which is burnt in the lower part of the flame.

It may be noted that, in these considerations, the solid particle theory of combustion is completely upheld; but the theory that it is always the hydrogen in a hydrocarbon that first burns —thus liberating the carbon to form the glow—is unsound, and no longer tenable.

Water Gas and Benzene.

In the preparation of the gas, steam was passed through a tube filled with coke, and kept at a bright red heat. The gas produced contained no air, but 10 per cent. of carbon dioxide, which was removed by treatment with caustic soda. With this gas, 0·079 gramme of benzene per litre gave 0·51 candle; 0·154 gramme, 12·9 candles. Hence, 0·075 gramme of benzene was required before any luminosity could be produced; and after that point was reached, enrichment at the rate of 0·006 gramme per candle ensued. On comparison with previous experiments with disillumined coal gas, these figures tell against the use of benzene with a gas containing a high percentage of carbon monoxide in a general way; but its economic bearing, taking into consideration the rapid rate at which carburetted water gas can be manufactured, I cannot now enter into.

Note the shape of the flame of water gas and benzene. It is like an ordinary gas-flame without a top to it. This is no doubt due to the fact that little or no CH_4 is present to decompose into C_2H_2 and C at the hottest and highest part of the flame. If, however, we add to this flame an enricher like pentane, which by itself, in any reasonable quantity, does not add any illuminating power to the flame, but which, on decomposition in the lower part of the flame, would yield a large amount of CH_4, the flame nearly resumes its normal shape.

Benzene with Manchester Gas.

For the action of benzene as an enriching agent on ordinary coal gas, the figures given by authorities on the subject are most widely divergent. The following is a list: Bunte says 1 gallon in 10,000 cubic feet of gas gives 3·6 candles enrichment; Frankland, 2·9 candles; Hunt, 0·9 candle; Knublauch, 3·7 candles; Stenhouse, 1·3 candles; L. T. Wright, 0·8 candle.

The following experiment will suffice to show the effect of benzene on Manchester gas:—

	Union Jet.	Argand Burner. Arranged to Give the Most Light.
Manchester gas before enrichment	12·6 candles	21·0 candles (approx.)
Benzol added, or rather contained in the enriched gas, per 10,000 cubic feet	0·075 gramme per litre.	0·079 gramme per litre.
Illuminating power after enrichment	28·6 candles	23·5 candles.
Gain in luminosity by enrichment	16·0 ,,	2·5 ,,
Gain in illuminating power per gallon per 10,000 cubic feet. Average of three tests	2·7 ,,	0·5 ,,

Notice the extraordinary effect the burner has upon the results. But, further, these results do not appear to tally, even in the case of the union-jet burner, with those wherein disillumined gas was experimented upon; and I can only account for the difference by assuming that a sort of overlapping takes place in the illuminants contained in an ordinary coal-gas flame—in other words, that you cannot get the full value of the light-giving power of both the olefines and the benzene when burnt in any proportion together. If this be so, a cubic foot of gas enriched to 20 candles with olefines mixed with an equal amount of gas enriched to 20 candles with benzene, would not

* See JOURNAL, Vol. LXV., p. 310.

necessarily give 2 cubic feet of 20 candles; but the mixture would probably have a lower illuminating power.

The above supposition, if it be correct, must be of the greatest importance to the gas manufacturer; and I hope before long to be able to settle it by experiment. But it is the only explanation I can offer in regard to my own results, and to account for the discrepancies recorded by other observers; the influence of the class of burner used, great as it is, being insufficient. Data recorded relating to enriching values are absolutely useless unless both the composition of the gas to be enriched and the burner employed are stated at the same time.

Manchester Gas with Hexane.

	Union Jet.
Illuminating power before enrichment	13·2 candles.
Hexane contained in the enriched gas per 10,000 cubic feet	0·092 gramme per litre.
Illuminating power after enrichment .	17·3 candles.
Gain in illuminating power by enrichment	4·1 ,,

Equal to 0·62 candle per gallon per 10,000 cubic feet.

The foregoing experiments open up a very wide question. They show that, when the common union-jet burner is employed —and I suppose 80 per cent. of the burners used in this country are of that type—gas enriched to a high candle power, when tested in the ordinary manner, is of very little avail, when that enrichment is due to the presence of olefines or other hydrocarbons with a high percentage of hydrogen. Argand burners are not popular, and slit burners are said to be smoky. So the union-jet burner still holds the field.

The lights of Paris, with its 14-candle gas, are often compared with, and said to be equal in illuminating power to, those of the North, with gas of 20 to 30 candles. Why is this so? Some say because the atmosphere of Paris is clearer than that of our northern towns, and that therefore the lights shine more clearly; while others try to find a difference between illuminating power and illuminating effect—a distinction I am unable to understand. My own opinion in the matter, and one formed from the experiments here described, is that Paris gas, as Berthelot states, owes its 14-candle illuminating power almost entirely to benzene; so that the consumers really get what they are supposed to do—probably quite as much as we in Manchester get from our 20-candle gas, which is made from cannel (and therefore owes its illuminating power largely to olefines as well as benzene), and which the majority of us consume in burners ill adapted to its use. Gas enriched to 17 or 18 candles with benzene would be far better appreciated than 20-candle gas owing its illuminating power largely to olefines—that is, by the average consumer. The same considerations also hold good for petroleum enrichment as for olefines.

As regards price, benzene at 1s. a gallon is by far the most economical enricher with a union-jet burner; and its production from coke-ovens is continually on the increase. Should a great increase in its employment cause a rise in price, the gas-works might themselves manufacture it in summer for use in winter, when the market for coke and other bye-products would allow of this being done. But, anyhow, while the price remains at the present figure, it certainly ought to be used for the enrichment of gas.

General Conclusions.

(1) That of all enrichers, benzene, for the average consumer of gas, gives the greatest value for the money.

(2) Toluene and xylene are better enrichers; but their non-volatility precludes their employment.

(3) Naphthalene is the cheapest and greatest enricher; but it cannot be supplied with gas from the gas-works because of its non-volatility. It could, however, be used for the street-lamps with a carburetting apparatus, which would give 50 per cent. more light for a mere fraction. Were separate mains employed and water gas used in connection with naphthalene, the cost of street lighting would be reduced to a minimum.

In the course of the discussion upon the paper,

Mr. T. Banbury Ball (Rochdale) said, from the practical gas manufacturer's point of view, he differed *in toto* from Mr. Irwin in the method adopted for determining the value of benzol as an enricher. It was undoubtedly quite possible to use benzol in the way described; but there would be great difficulty in securing uniform results. Mr. Irwin's object was to show the value of adding benzol and other hydrocarbons as enrichers to ordinary coal gas; and the gas manager desired to know what, for example, benzol would do when added to 15, 16, or 17 candle gas. It was of little interest to him what its effect might be upon gas deprived of its illuminants, such as Mr. Irwin had used. The fact that an increase of 16 candles had been found when the enriched and unenriched gases were burnt in a union-jet burner (and a small one too), though only three candles' increase was found when the samples of the same gas were tested in an Argand burner, tended to show that the former was an entirely unsuitable burner for the gas tested before enrichment, and not that the whole improvement was due to benzol. The method adopted by Mr. Irwin, of passing the gas over the surface of the benzol, would probably be found to result in the liquid gradually becoming denser, and the enriching effect diminishing. This was found to be the case when the benzol was volatilized by steam heat; and one would expect it to be much more so when the gas simply carried away the benzol mechanically. Referring to the figures just quoted by Mr. Irwin, as to the values arrived at by Dr. Bunte and others, it was difficult to compare them without knowing the conditions under which the experiments were conducted; and while he should be delighted if the values quoted could be obtained in ordinary working, he was bound to say that as yet they had only been able to approximately reach the figure given by Mr. Stenhouse in his paper read at the previous meeting.*

Mr. W. Thomson asked whether Mr. Irwin had made any experiments by burning the different mixtures of gases under pressure or by means of hot air, as in the Wenham burner. He also wished to know if Mr. Irwin could explain the reason why two little wings of light formed at each side of the flame when burning naphthalene as an enricher.

Dr. Lewkowitsch wished to know how Mr. Irwin had estimated the solubility of benzene, as the paraffins experimented on were doubtless of American origin. He suggested that Russian petroleums should be tried; the naphthalenes in this petroleum forming an intermediate group between the open-chain paraffins and closed-chain benzenes. As to the theory of the flame, would it not be advisable to burn the gases in Smithells' flame-dividing apparatus, and examine the gases?

Mr. H. Grimshaw expressed his disappointment that nothing had been said about acetylene, which, according to recent reports, was coming to the front for enriching coal gas. In his opinion naphthalene used as an enricher of coal gas was still the cheapest, especially at the present price of about £9 per ton; and he thought the most practical outcome of the discussion would be to ascertain whether acetylene or naphthalene would be the cheaper. In his own mind, he considered that acetylene was not destined to be a rival of the other materials used for the enrichment of coal gas.

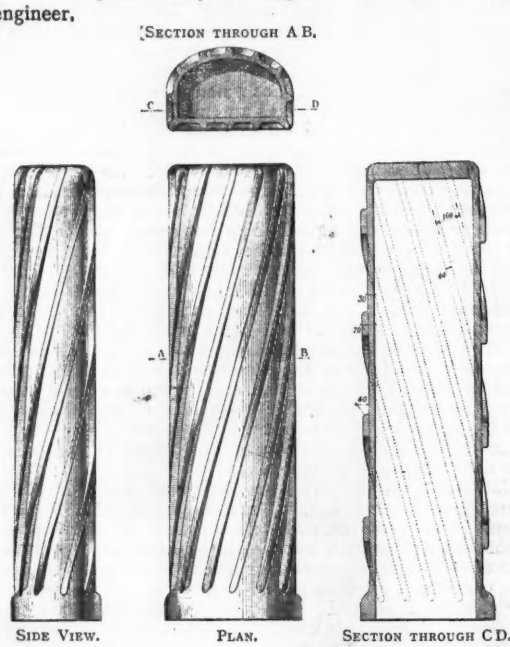
Mr. T. Stenhouse thought the paper would have been of much greater interest had Mr. Irwin explained how the experiments had been carried out, the kind of burners and the photometer employed, and whether he had used ordinary coal gas of 15 or 16 candle power or disillumined gas. How was the gas enriched by the naphthalene? Were the enrichers used weighed or measured? The paper contained very little information on these points, though the results appeared to have been calculated out very finely.

Mr. Irwin, in reply to Mr. Ball, said he distinctly stated that his experiments were made with the burner most commonly employed—viz., the union jet. He was fully aware that the Argand burner, which was chiefly used for testing in gas-works, had not given high results with benzene. But he regarded the question from a consumer's rather than from a gas manager's point of view; and, so regarded, he considered benzene the most economical enricher. With respect to the carburetting apparatus, he never suggested that the laboratory method he had mentioned could be used on a large scale. Were he carburetting in a works, he would use either such an apparatus as that suggested by Bunte or possibly a simple tower packed like a scrubber, up which the gas might pass and meet and absorb a stream of benzene descending. In reply to Mr. Thomson, the reason regenerative burners gave more light was in all probability that the additional heat supplied caused a greater quantity of marsh gas to be changed into acetylene with less waste in merely maintaining the heat of the flame. In reply to Dr. Lewkowitsch, he had estimated the solubility of benzene in water merely by agitating the benzol and water together; taking the precaution not to allow more air than possible to be admitted into the mixture. Just before the point of concentration, the mixture formed a froth, which disappeared again the moment excess of benzene was added. The data given represented volumes of liquid benzene, and not vapour of benzene. With regard to naphthalenes, he had not made any experiments with them; but he should expect they would follow, in their carburetting power, the theory he had advanced. In the paraffin series, generally speaking, the higher they were in the series the greater was their enriching value. With reference to Mr. Grimshaw's remarks, he had at first intended to institute comparisons with acetylene; but as the paper was getting lengthy, and acetylene was being put out of the field altogether by its introducer, Professor Lewes, he decided to leave it alone. In reply to Mr. Stenhouse, the kind of photometer employed was one of the Bunsen pattern he had constructed for use in his laboratory. It was not on so elaborate a scale as a gas-works photometer; but any error due to the instrument itself would not be sufficient to affect the theory he advanced as to the constitution of enrichers, and its relation to their enriching power. In the case where such bodies as naphthalene were employed, the burner had to be kept in contact with the stopper of the vessel containing the enricher at a constant temperature of (say) 100° C. Trials had to be made at first to find at what temperature the best result could be obtained with the substance to be experimented upon, and afterwards the test made. He had arranged an apparatus by which he could pass a constant stream of gas—say, half a cubic foot—over the enricher. It would be interesting to test a benzene hydrogen gas with a regenerator, in which case he doubted whether the gain in enrichment would be anything like so great as with ordinary gas. It would be his desire, at some future time, to repeat these experiments with more elaborate apparatus, and (with the aid of experience already gained) complete the work.

* This paper will be found on next page.

GUEGUEN'S PATENT RETORT.

The attention of gas managers is invited to a novelty in retorts the nature of which will be understood by a glance at the accompanying illustrations. They represent the helicoidal ribbed retorts patented by M. Guéguen, a well-known French gas engineer.



Side View. Plan. Section through C D.

The advantages claimed for the system are the reduction of the thickness of retort walls which it permits, without detriment to the strength of the retort, and the consequent saving of heat. Experiment has demonstrated that it is greatly due to the resistance to the passage of heat from without to the charge of coal in an ordinary retort, that the carbonizing process lasts so long, and that such a high temperature is required in the setting. By reducing the thickness of a fire-clay retort from 2¾ inches to 1¼ inches, there is an increase made of 32 per cent. in its heat-transmitting capacity; and M. Guéguen claims to have found, with trial retorts of his special design introduced in a setting with others of the ordinary construction, an increased carbonizing capacity of 20 per cent. With helicoidal retorts 3 centimetres (1·185 inches) thick, an increased carbonizing power of 25 per cent. has been obtained. It is also claimed that retorts with compensating helicoidal ribs run less risk of breakage during transport; and they are better baked than the ordinary thick retorts. The virtue of the new retorts, of course, resides wholly in the reduction of their substance—the helicoidal ribs are merely to compensate for the loss of strength due to this feature. Taking into account the value of the improved carbonizing effect of these retorts as compared with those of the ordinary pattern, it is claimed for them that they represent an economical advantage of £16 per retort per annum over the common make.

Trial retorts upon the new system have now been at work for twelve months; and these show no cause to suspect them of inferior durability to other kinds.

EXPERIMENTS WITH LIQUID GAS ENRICHERS.

In the JOURNAL for the 7th of May last (p. 943), we noticed briefly a paper on the above subject, read by Mr. T. STENHOUSE, F.I.C., F.C.S., before the Manchester Section of the Society of Chemical Industry. The text of the paper has since appeared in the Society's *Journal*, from which we reproduce it.

During the last few years, many gas managers, instead of using cannel coal, have raised the quality of the gas obtained from ordinary coal to the required standard by using liquid enrichers. These have been vaporized by steam in various kinds of carburettors. Generally the gas is improved 2 or 3 candles in this way. There is, however, a great difference in the few published statements respecting the value of the various hydrocarbons commonly in use—especially of carburine and benzol; and probably there is as great a difference between the privately circulated results believed to have been obtained at various gas-works where enrichers of this class are employed. Dr. Bunte, for instance, makes the rather wide statement that between 7 and 9 grains of benzol vapour will improve 1 cubic foot of gas between 4 and 5 candles. This is equal to an improvement of 1 candle in upwards of 30,000 cubic feet of gas by 1 gallon of benzol.

In a letter to the JOURNAL OF GAS LIGHTING (Feb. 19, 1895), Mr. Hunt, of Birmingham, stated that 1 gallon of benzol enriches 9500 feet 1 candle, and that 1 gallon o carburine will improve 2800 cubic feet to the same extent. In an interview with Mr. W. Young, of Peebles, this gentleman credited a gallon of benzol with an enrichment value of only 4500 candles, and carburine with being only one-fourth as effective. These statements are so greatly at variance, that a gas manager, wishing to select some enricher of this kind for his gas, must be not a little perplexed, and scarcely able to calculate what the cost will be. Of course, it is quite possible that gases of the same illuminating power may so differ in composition that no particular enricher will have exactly the same improvement effect upon them. This, however, cannot account for the differences just noticed.

With a view of ascertaining the relative values of a few enrichers for coal gas, I have recently made some careful experiments with several liquids, but principally with carburine of ·680 sp. gr., and commercially pure benzol. The gas used was of about 16-candle power, and was improved from 1 to 2 candles. The photometer employed was the ordinary 60-inch open bar photometer at the Rochdale Gas-Works. A Methven 2-candle screen replaced the candles, so as to avoid any trouble with the latter during the tests. The gas, after leaving the meter, was bye-passed through two flasks with short lengths of glass tubing. The first flask it entered was a small one holding a quarter of a litre; the other had a capacity of 2 litres. The inlet-tube reached nearly to the bottom of the small flask, while the outlet-tube only just passed through the cork. The tube arrangement was reversed in the larger flask—the gas entering at the top, and leaving at the bottom. The lower part of the small flask was heated on a water-bath; and the liquid enricher was allowed to fall in drop by drop. In this way the gas was enriched each time a drop entered and became volatilized; but as the gas immediately passed into, and became diffused through, the larger flask, there were only very slight variations in the illuminating power of the improved gas when the enricher was added uniformly for about 15 minutes. With a few trials, it was soon ascertained at what rate the liquid, whatever it was, must be added to give 1 or 2 candles enrichment, and allow accurate readings to be taken at the photometer. The liquid enricher was measured from a burette with a glass tap, and passed into the flask at the required rate. After the gas had been improved to a suitable extent, and was burning at the proper rate, the liquid in the burette was carefully read off, and a test, lasting (say) half an hour, was made.

With an arrangement of this kind, it is not at all difficult to watch the photometer disc, and regulate the supply of the enricher, so that the illuminating power of the gas shall remain fairly steady at one value—say, at 18 or 19 candles, as may be required. Certainly the difference between the readings is not greater than what is experienced when using candles in the ordinary way while testing unenriched gas. With the addition of one drop of benzol from the burette every 20 seconds, one can get an improvement of about 2 candles when the gas is burning at 5 cubic feet per hour. Between two and three times as much carburine is required to give the same improvement.

Added in this way, practically all the liquid is vaporized under the influence of heat and the stream of gas playing over the bottom of the small flask. Even with enrichers containing small quantities of dense hydrocarbons, there is a mere stain left in the flask after an hour's test. Under these circumstances, one may safely rely on obtaining the full duty from the liquid under examination, as it is practically all turned into vapour, and carried directly into the flame, of which the illuminating power is being determined. As the flame is never more than equal to 18 or 19 candles in these tests, the gas is never saturated with the added vapour, and consequently will have no tendency to deposit anything either in the larger flask or in the short length of tubing leading to the Argand burner. It may here be remarked that at Rochdale, where carburine has been employed as an enricher during the last two or three years, Mr. T. Banbury Ball, the Engineer and Manager of the Gas-Works, has not found that any of the liquid has condensed in any of the syphon-boxes attached to the mains, notwithstanding the severe frost of last winter.

Working in the way just described, the following results have been obtained with the respective liquids:—

	Gas Enriched 1 Candle by 1 Gallon of the Liquid.
Benzol (chemically pure)	13,300 c. ft.
Benzol (90°)	12,500 ,,
Carburine (·680 sp. gr.)	5,700 ,,
Common petroleum spirit (·700 sp. gr.)	4,300 ,,

Of these liquids, the two important ones are commercially pure benzol and carburine or light petroleum spirit. Their composition is well understood. As the specific gravity shows, a gallon of the former contains about 2 lbs. more real matter than the latter. Besides this, the molecular structure of the benzol molecule is such that, of all the liquid hydrocarbons known, it is the one which may be expected to break up most readily into that wonderful acetylene of which we have heard so much lately, and which, according to some authorities, puts everything else in the shade as a light producer.

Benzol is a liquid which is being produced more plentifully every year from the gas and tar obtained from coke-ovens. It was recently estimated that 50 million gallons of benzol could be obtained from the 30 million tons of coal annually coked in Great Britain, if the coking were done in closed ovens. There is, therefore, every probability that this most useful liquid will

be available in greater quantities in the near future. It is already a rival of carburine; and it may soon supersede it altogether for enriching ordinary gas of 15 or 16 candle power. So long as benzol can be purchased at 1s. per gallon, it is, in my opinion, decidedly preferable to carburine, even at the lowest price at which the latter has yet been sold. Volume for volume, it is about 2¼ times as efficient as a gas enricher; and there is less loss and danger from evaporation during transit. The temperature at which benzol volatilizes is also a convenient one, as ordinary steam heat is all that is required. The amount of benzol vapour which common coal gas can permanently retain —viz., over 50 grains per cubic foot at 0° C.—is greater by far than anything required to enrich low-quality gas to any reasonable extent. If used in a rational way, there is therefore no need to fear that the added benzol will be condensed and deposited in the gas-mains.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by correspondents.]

The Discussion on Mr. M'Crae's Gas Institute Paper.

SIR,—In your last issue you publish Mr. M'Crae's paper, read at The Gas Institute meeting, and the discussion thereon. The remarks I made on that occasion were so entirely misunderstood by all the speakers who took occasion to refer to them afterwards, that I think my hoarseness must have rendered my meaning very obscure. Speaking was very painful to me; and, as time was pressing, I refrained from asking the President's indulgence while I made an explanation—preferring to wait until the report appeared, when I might claim your indulgence instead, to enable me to put myself straight, as far as may be necessary, although, after seeing my observations in print, I am puzzled to know how they could have been so misunderstood.

The curt manner in which you put my observations aside, in the leading article on this subject in your last issue, as not even to be taken seriously, only shows, to my mind, the obtuseness of people constantly occupied in writing for a purely technical journal on matters affecting the larger questions of humanity. You work in that old aphorism about "two blades of grass." I might reply with another about filling two mouths with food. But that is not serious discussion, however suitable it may be for leading articles. There is no question of making two blades of grass grow here. It is simply a question of the best way of making the same blade grow in the same place year after year. My contention is that it is better to do it ourselves, and have the benefit distributed among ourselves, so long as we can do it as well and as cheaply as anyone else, rather than call in the assistance of someone in Russia or America, and let him share a portion of the benefit.

I wish it to be distinctly understood that underlying my remarks was this sentence of Mr. King's: "Quite independently of the economical production." Anything that will lessen the cost of production in any way does not fall under the pale of my observations; and therefore Mr. Denny Lane, with his ponderous sledge-hammer, does not find even the proverbial tack to drive home. I am as much in favour of real labour-saving appliances, and economy of production in every form, as anyone who spoke at the meeting; and in my practice I never allowed any consideration for the men to stand in the way of those things. Mr. Duxbury caused a laugh by drawing attention to something I said in a letter some time ago; but if he had understood what I was talking about, he would have seen no inconsistency in that. It was always my policy to get full value for all moneys expended, whether in the shape of wages or otherwise; but I never went to my Committee and asked them to put in machinery of any kind to dispense with labour because I was unable to manage my men. Mr. Stelfox made the most reasonable and effective reply to what I had said. He frankly admitted that the men had acted unreasonably towards himself ("put to the torture" is a strong expression, but it is his own); and therefore he felt inclined to give them one back. Well there is a good deal of human nature about that; but it is not more reasonable than the stand previously assumed by the men.

It may be said that every man is a philanthropist so long as it costs him nothing. It is evidently so with Mr. Alderman Miles, of Bolton. He has been a believer in conciliation up to quite a recent date; he has even advocated it in public and at our meetings. But some time ago the Corporation had a dispute with their men, and the men were, of course, unreasonable—could not, or would not, see eye to eye with Mr. Alderman Miles, and so he conciliated them with the Conspiracy Act. The men were told on one occasion that, if they did not accept the conciliation meted out to them, they—the Bolton Corporation—would have to *resort to stoking machinery* (the italics are my own). Fancy the resort! I have heard it stated, and I believe the statement, that there is at least one of the London Suburban Gas Companies using stoking machinery alongside of hand labour, and that they have found the hand labour to be as cheap, if not a cheaper way of making gas or carbonizing coal. So that, after all, Mr. Alderman Miles was well advised in using the word "resort." If men are obtainable in the neighbourhood of those works, I contend that it is an injustice to the district from which those works derive their revenue to have substituted machinery for hand stoking, if they are not making any additional profit by it. I wonder what a working-man director would say if the manager proposed to substitute machinery for labour, not because it would save money, but because it would save him the trouble of looking after so many men. I think a working-man director, if he understood the business, would be a very wholesome influence in many places. Perhaps it would be worth while considering what the status of the gas manager will be when eight men are employed to do the work of 340. In gas-works that now employ 40 men, there will only be one; and that will be the manager himself, who, being an energetic person, will do all the work required. However, as that is the manager's affair purely, I will leave it for the present.

This is a very large question, and one can hardly expect to get it thoroughly understood and threshed out in one discussion. Indeed, it is questionable if another century will see it. But, even in this early stage of the discussion, I protest against it being taken as an axiom that it is better in every respect to employ 20 men instead of 200, apart from economical considerations. I say the reverse is the case. That the man who can feed or provide a good living for 200 men is ten times the benefactor of the man who only provides for 20. To speak of throwing 180 men out of employment, for no other consideration than that it shall save you a little trouble, is inhuman. Perhaps it may have arisen from mere thoughtlessness. But the effect of thoughtlessness may easily be inhuman; and it was my purpose to place it on record that all the members of The Gas Institute did not subscribe to this doctrine.

One thing is certain, that labour is gradually awaking and finding its feet, and is following the natural bent of all humanity in trying to raise its own status. That it is indiscreet and unreasonable at times is only another way of saying that it is ignorant, or not yet fully awake. Hence its liability to trust its affairs to outsiders, who often do it more harm than good. But it will go on, and force its claims upon you; and I contend that the gas manager or the employer, whatever he may be, will display the greatest wisdom who keeps in sympathy and in touch with his men, who tries to understand their case and see their point of view, rather than the one who takes refuge behind the shelter of an unprofitable machine.

Altrincham, July 11, 1895. W. CARR.

The Manufacture of Sulphate of Ammonia.

SIR,—In your issue of June 25, you have a paper by Mr. C. Stafford Ellery, of Bath, upon "Some Improvements in Methods of Manufacturing Sulphate of Ammonia;" among these improvements being that figured in your pages as "Ellery's Self-Emptying Saturator." We do not know how long Mr. Ellery has had his self-emptying saturator at work; but we should like to point out that we designed a saturator on the self-emptying principle, and actually took out provisional protection for it, as long ago as 1890. Our first design was almost exactly like Mr. Ellery's saturator—even to the treacle valve. But as we had misgivings as to the quantity of liquor which would leave the saturator along with the salt, we made considerable changes, with a view to obviating this possible difficulty.

Manchester, July 8, 1895. DAVIS BROS.

Sloping Retorts at Brentford.

SIR,—In reply to Mr. Graham's letter on the above subject, in the JOURNAL for the 2nd inst., the first installation of inclined retorts was not worked at Rochdale. No improvements have been made since the first installation at Brentford. In my paper, I do not make a claim for any size of retort—it would be absurd to do so; neither do I recommend or use taper retorts. As a matter of fact, our retort mouthpieces are contracted an inch, making them 23½ inches; and we get a rapid discharge of coke. We have no lug on the discharging iron mouthpiece; and this was neither mentioned nor claimed in my paper. No. 2 house is an exact copy of No. 1, excepting that the retorts are larger in the former; and all improvements in No. 2 house have been used in No. 1 for years. I believe our re-installation of sloping retorts (72 sets), which will be at work in the coming autumn, is the largest in England. Mr. Ball does not claim the three shoots, as we modified the first Southall pattern, after experiment, for convenient and rapid charging.

Brentford, July 12, 1895. J. HUSBAND.

Professor Lewes's Report on Gas-Fires.

SIR,—It is with great diffidence that I take the liberty to endeavour to add to the work of so brilliant a scientist, and so worthy an author, as Professor Vivian B. Lewes. But, alas! when one sees in his paper, on "The Combustion of Coal Gas for Fuel Purposes" the small fault so explicitly stated that has long barred the commendation of an article which possesses many good points, it rouses one to the use of the pen. I refer to the "Condensing" gas-stove; and I am exceedingly sorry to see no test of it in so comprehensive a dissertation on the somewhat important subject of heating by coal gas.

This class of stoves has for a long time been catalogued; and though they do not give all the much-to-be-desired radiant heat, they give a portion, and certainly a useful heating duty (per cubic foot of gas consumed), unequalled by any other stove known to me in the trade. In conjunction with the late Mr. F. Weller, I had the pleasure of making some rough tests on one classed in a well-known firm's list as "6 P.S." The stove was placed in an apartment with an eastern aspect, 16 feet by 12 feet and 10 feet high; and it gave, with a consumption of 8 cubic feet of gas per hour, an amount of heat which surprised us both.

It needs no demonstration to prove that the products of combustion of so small a quantity of gas are hardly worth consideration; though doubtless a test of the humidity of the air in the apartment would have here been useful.

A consumer who tried one for heating his office had an account of about 35s. per quarter; and I question had this said consumer been left to one of such stoves as Professor Lewes mentions, with gas at 4s. 6d. per 1000 cubic feet, whether his bill would not have amounted to £7 or £8 per quarter, with the unfortunate result in his case of the abolition of heating by coal gas.

The main things to be insisted on from the stove maker are: (1) The governor underneath the Argand burner should be such that, when subjected to the maximum amount of pressure, it will not allow a greater amount of gas to pass than the surface of the stove will properly condense all the vapours given off from its combustion. (2) The receptacle for the condensed liquid should be of such a size that it will take easily all the liquid formed in twelve hours. (3) The stove should be properly japanned, or the pores of the material of which it

is made filled up by some suitable medium. (4) The inside of all the parts should be easy of access when taken to pieces.

No doubt, many managers are allowing stove makers to place with them a stock for disposal during the ensuing winter; and should they feel inclined to give this class a trial, I believe they will have little room for regret.

Clapton, July 11, 1895. J. STEEL JOHNSON.

The Working of the London Gas Companies.

SIR,—In your issue of June 25, a correspondent wants to know, "How is it that the South Metropolitan Gas Company require only 1·31 per cent. of cannel to enable them to supply 16·4-candle gas, while the Crystal Palace District Gas Company, to supply 16·2-candle gas, use 3·08 per cent. of cannel—both Companies being under the able management of Mr. George Livesey."

As you point out, it is an error to suppose that Mr. George Livesey is the Manager of either of these Companies; but it is also the fact that practically during his working life Mr. George Livesey was the Manager of the South Metropolitan Gas Company, and that *management* is the cause of the difference in the percentage of cannel to which your correspondent refers. And I have no doubt that very shortly the cannel used by the Crystal Palace District Company will bear a close comparison with that of the South Metropolitan Company, though Mr. George Livesey is not Manager, but only Chairman.

I make this statement advisedly, and for the following reasons: During the last twenty years, I have watched the career of Mr. George Livesey carefully, and always found that, when that astute gentleman is either Manager or Chairman, the price of gas invariably goes down, and with it the percentage of cannel.

I believe I am right in stating that, for many years, Mr. Livesey made gas much above 16 candles without using any cannel (or other enricher) at all; and I expect to see this result again.

Just as there is a Champion Cricketer, so there is a Champion Gas Manager; and those who don't walk about with their eyes shut know it.

342, *Strand, W.C., July* 8, 1895. V. TAYLOR, F.C.S.

P.S.—I may add that I have no connection with any gas company.

The New Water-Works for Cookstown (Ireland).—The Local Authority of Cookstown have applied to the Local Government Board for Ireland for a further loan of £1500 for meeting the balance of expenditure on their new water-works. According to the evidence laid before the Chief Engineering Inspector of the Board (Mr. C. P. Cotton), the works have cost £5391; land and wayleave, £2403; law and engineering charges, £1257; and sundries, £86—making a total of £9137. The original loan was for £7760.

New Offices for the Cardiff Gas Company.—The foundation stone of the new offices and show-rooms of the Cardiff Gas Company (a short description of which was given in the JOURNAL for May 7 last) was laid last Wednesday, by Mr. C. H. Williams, the Chairman of the Company. In addition to the Directors, there were present Mr. E. J. Phillips, the Chairman of the Newport Gas Company; Mr. G. Clarry, the Secretary of the Cardiff Company; and Mr. H. Morley, the Engineer and Manager, to whose designs the buildings are being constructed. The interesting ceremony commenced by the Contractor (Mr. James Allan) presenting to Mr. Williams a handsome silver trowel and ivory mallet, with which he discharged his pleasant task. The stone was inscribed as follows: "This memorial stone was laid by Charles H. Williams, Esq., J.P., Chairman, on the 10th of July, 1895. H. Morley, Engineer and Manager; James Allan, Contractor." The trowel was also suitably inscribed on one side, and on the other was an engraving of the new offices. Through the generosity of the Chairman, the workmen engaged upon the building subsequently partook of a substantial repast.

The Charging of the Extra Expenses Occasioned by Last Winter's Frost.—It may be remembered that at the meeting of the Grand Junction Water Company on the 12th ult., a question was raised as to the charging of the extra expenses occasioned by the severe frost of the past winter. A sum of £6015 appeared in the accounts. But it turned out that this was not the entire amount spent by £6000; and the shareholders' Auditor (Mr. R. A. M'Lean) had some correspondence with the Directors on the matter. He learnt that it was their intention to spread the whole expenditure over two half years, though it had all occurred in the six months covered by the accounts; and he was told that the matter of the balance would be referred to at the meeting. Mr. M'Lean protested against this course, and accordingly appended to the accounts a note in regard to the item. This action gave rise to some criticism at the meeting, seeing that the Government Auditor and Mr. M'Lean's own colleague differed from him. An auditor's duty, in a case of this kind, has been the subject of some correspondence in the Money Article of *The Times*—a writer under the signature of "Chartered Accountant" expressing sympathy with Mr. M'Lean in his position. The latter gentleman has replied by giving a statement of the case, and concluding with the following points of general interest which, he says, arise thereon: "(1) That all loss sustained during a given period should be shown in the accounts of that period, no matter when afterwards repaired. (2) That the omission to show the whole loss cannot be justified by any private arrangement between directors and auditors to make future profits bear a part of it. Such a practice, if once sanctioned, is capable of unlimited abuse. In this case the whole loss could easily have been shown, one-half of it charged, and the intention to spread the other half stated. (3) That no promise from a board to refer, at a future meeting of shareholders, to losses sustained, but not shown, in these accounts, can justify an auditor in certifying those accounts to be correct. (4) That while auditors are bound, come what may, to secure truth and accuracy in accounts, a corresponding obligation rests on shareholders to support them in the performance of that sometimes delicate and trying duty. The extent to which that support may be withheld, through apathy, indifference, or design, is the measure of the encouragement which shareholders give to the publication of erroneous accounts."

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE IN IRELAND—CHANCERY DIVISION.

Friday, June 28.

(*Before the* MASTER OF THE ROLLS.)

Alliance and Dublin Consumers' Gas Company v. Corporation of Dublin.

The hearing of this action, which was brought by the Alliance and Dublin Consumers' Gas Company against the Corporation of Dublin to have the award of December, 1889, in relation to the meters attached to the public lamps, carried into execution and specifically performed by the Corporation (see *ante*, p. 42), was resumed to-day. The Company also applied for a mandatory injunction to compel the defendants to remove all defective meters from the public lamps, and to provide in lieu thereof proper meters within the meaning of the award, for the purpose of ascertaining the consumption and rate of consumption of gas supplied by the Company to the defendants, and for an inquiry as to the damages sustained by the Company by reason of the defendants' breaches of the award. The Corporation in their defence alleged that the meters were proper ones within the meaning of an award in an arbitration between themselves and the Company.

Evidence having been given on behalf of the Corporation, witnesses were called by the plaintiffs to rebut it; and the further hearing of the case was adjourned.

Saturday, July 6.

To-day judgment was given.

The MASTER of the ROLLS said the action was brought by the Gas Company against the Corporation; and the plaintiffs prayed to have an award dated Dec. 16, 1889, in reference to certain meters, carried into execution and specifically performed. They also applied for a mandatory injunction to compel the defendants to remove defective meters, and to provide in lieu thereof proper meters within the meaning of the award, and for an inquiry as to damages. He might say, as regarded the damages, that he had heard nothing in reference to them, nor anything that would suggest to him that there ought to be such an inquiry in any event. It appeared that plaintiffs had been supplying the city of Dublin with gas; and, in the course of the proceedings, a submission to arbitration was entered into, and an award was made which provided that the Company should sell, and the Corporation should purchase, the public lamps at a price to be settled by two arbitrators. Then it specified that the Corporation should "provide proper meters for all metered lamps." The average meter system was to continue to be used; the metered lamps to be one in every twenty. The short case on behalf of the Company was that the Corporation had provided defective meters, which were not in compliance with the award. The Corporation, in their statement of defence, said the meters provided were, within the meaning of the award, proper meters. On behalf of the defendants, it had been argued that another part of the award—in reference to a photometer—had not been complied with by the plaintiffs. But this had not been brought before him for decision; and it did not afford an answer to the claim of the plaintiffs. The award said: "The Corporation shall provide proper meters." In his opinion, some meaning must be attached to the word "proper" in the collocation in which it appeared. In the course of the discussion on the case, he intimated a very clear and concluded opinion that the stamping and sealing of meters under the Gas Acts was not conclusive as to the proprietary of the meters within the clause of the award; for the stamping and sealing required by the Act of Parliament was a legislative, statutory minimum of requirements, without which meters could not be issued for the purpose of regulating the relations of providers and consumers of gas. But this statutory requirement, without which no meter could be supplied for public use, seemed to have, in the contemplation of the parties to the award, something underlying the whole of it, but not at all determining the particular class of meters to be used for this specific purpose. The whole of the evidence showed that there were different kinds and qualities of meters—all of them satisfying the statutory requirements. It was not contended that the meters were proper meters within the award, if they were not rendered proper by the sealing of the Board of Trade authority. Nor, indeed, could it; because otherwise the very cheapest and most inefficient meter would fall within the terms of the award. But that there was something much further and more important was demonstrated by the clause which specified that the average meter system should continue to be in use. This system was that the consumption of gas was not to be the subject of complete measurement by meter, but that in lieu thereof, one lamp out of every twenty was to be provided with a meter. If it was a perfectly accurate meter, it made no difference whether it was applied to one or to twenty lamps; but if there were any inaccuracy in it, then the importance of the inaccuracy was measured, not by the consumption of one, but by the consumption of twenty lamps; in other words, any error must be multiplied by twenty. Now this was, in his opinion, the exigency of the award. The meters must not only be meters stamped and certified; they must be proper meters under all the circumstances. It appeared that the city of Dublin had been subject to the average meter system before, and the meters used were placed in the body of the lamp-posts; and it was said by the defendants that the same award which provided for proper meters provided also for the taking over by the Corporation of the existing lamp-posts, many of them being previously fitted with meters, and that it must be considered to have been within the contemplation of the Arbitrators that the new meters which were to be provided should take the place of the old ones, and should be of such a size as to fit within the lamp-posts. There were at present 188 meters; but the number of lamp-posts the Corporation took over which were fitted for the reception of meters was 1345. Therefore, as to about 1150, it could not have been within the contemplation of the parties that they should have been used for meters at all. The correspondence in the case showed plainly that the Company,

when they found that it was the intention of the Corporation to use small meters, were perfectly and absolutely astonished at such an intention; because this circumstance was proved by all the witnesses, that in no other city or place in the three kingdoms in which the average meter system had been adopted was there any instance of meters such as were employed in the present case being selected for the purpose—viz., small meters, limited in capacity by the position in which they were to be used, being located in the lamp-posts. It was a question of fact whether the meters that had been provided were, under all the circumstances, proper meters or not; and the onus of showing that they were not rested on the Company, who had produced a considerable body of scientific and practical evidence. He could not but regret that the Corporation did not act upon proper advice as to the kind of meters they should purchase. The Corporation were trustees for the public, and no doubt it was their duty to exercise a strict and proper economy over their expenditure; and he felt bound to say there was nothing in this case that was in any way discreditable to the Corporation, to their officers, or to the Gas Committee. He did not question their *bona fides*. But this was not the point. Their desire for economy might have led them astray in this instance. Whether it had or had not, this was a case in which a little liberality might have been very prudently and economically exercised. He passed from this to the evidence with regard to the absolute unfitness of the meters used. Having reviewed the evidence at considerable length, his Lordship remarked that upon it he had come to the conclusion that the vast preponderance of it was in favour of showing the inadequacy of the meters. Other matters had been introduced into the case, to which he wished briefly to refer. He had already dealt with the stamping and sealing; and on the question as to whether or not the meters were intended to be fitted into lamp-posts, he was of opinion that the Arbitrators had not this in contemplation when they made their award. With regard to the interview between the deputation from the Company and the Gas Committee of the Corporation, in view of the evidence adduced, he must hold that there was nothing definitely arranged at that meeting. How, then, did it come about that the Corporation ordered meters which were not proper ones? In his opinion, it was due entirely to over-economy. The more strained the relations between the Company and the Corporation were, the more important was it, in his opinion, that the Corporation should have exercised extreme caution in carrying out the award. The difference of cost would have been trifling. The cost of 188 meters supplied, at £1 5s. each, was about £230; and the cost of the underground meters, which would undoubtedly have been efficient and proper, would, at £5 10s. each, be about £1000. In February, 1891, long after the award was made, the Corporation were informed that the underground meters at £5 10s. were by far the best. The firm selected to supply the meters never dreamt of suggesting that they should supply the small overground meters. Their interpretation of the requirements of the Corporation was that they should supply the large meters in an iron box to be placed underground. They said "they were the best for the purpose, and could be relied upon," and that "they were by far the best." As regards the small meters, they said subsequently that "they might do"—that was to say, they might *not* do—but that "the others were by far the best." As he had said, he thought the more strained the relations were with the Gas Company, the more imprudent it was for the Corporation, in the face of this advice, not to have gone and shown the correspondence to the Company, and said to them: "What do you say about it?" If they had done this in the first instance, it was more than probable—indeed, it was quite certain—that the point at issue would have been raised before they were committed to the order and before the matter was closed. He did not pause to condemn, because it was not his business to do so; but he did refer to the circumstance that, in the correspondence and letters which appeared before him, the statement was conveyed to the Company by the Gas Committee of the Corporation that they had had an assurance that the meters provided were the very best that could possibly be procured for the purpose. This they stated in black and white. No doubt it was a mistake, but it was an important mistake, and one that ought not, under the circumstances, to have occurred. He was of opinion that the meters employed did not correspond with the award; that there was no legal answer to the action; and that there must be an injunction to the Corporation to replace them by others that should be proper meters under all the circumstances of the case.

Mr. W. KENNY, Q.C. (for the Company): Of course, that is a decree with costs.

The MASTER of the ROLLS: The decree must go with costs.

Mr. KENNY asked that, having regard to the scientific witnesses that had been produced, the costs should be taxed on the higher scale.

Mr. C. O'CONNOR, Q.C. (for the Corporation), argued that taxation on the lower scale would meet all the witnesses' expenses.

The MASTER of the ROLLS said he was not sure that it would; and he thought the case came within the order for costs on the higher scale. The plaintiffs were entitled to a decree in the terms of their petition, with costs. His Lordship added that it was to be regretted that the Arbitrators did not, in their award, exactly define the meter that should be used.

The Stroud Water Company's Debenture-Holders.

Last Saturday week, as already reported in the JOURNAL, Mr. Justice Stirling made an order, in the action of a debenture-holder of the above-named Company, directing an account of what was due to the plaintiff and the other debenture-holders, and giving the Liquidator liberty to apply to the Court in regard to the payment of moneys coming into his hands. His Lordship was asked to enlarge the order by extending power to the receiver to pay the expenses of maintaining the Company's works; but he declined to do so, on the ground that he would not interfere with the direction of the Company. The application was repeated last Thursday before Mr. Justice Kekewich, who was hearing Mr. Justice Stirling's petitions. Counsel said the matter had become urgent; and if provision were not at once made to meet trade debts, the Company must cease operations. Though the request was supported by Counsel representing the Company, his Lordship refused to interfere; considering he had no jurisdiction practically to set aside his learned brother's directions.

Liability for the Restoration of Roads.

At the Chepstow Petty Sessions, on the 2nd inst., the Chepstow Water Company were summoned, at the instance of the Monmouthshire County Council, for breaking up a main road at St. Kingsmark, and not afterwards leaving it in a proper state of repair. The Company, through their Secretary (Mr. C. Evans), denied their liability, on the ground that the road had been opened by a contractor named Jones, who was erecting the St. Maur College. The County Surveyor (Mr. W. Tanner) stated that about 200 yards of the road in question had not been properly reinstated after the laying of the water-mains. The Bench asked Mr. Evans if he could refer them to any case which would put the responsibility upon Mr. Jones. Mr. Evans said he informed the District Surveyor that Mr. Jones had opened the road on his own account; and he began the work before the Company knew of it. The only part of the road the Company had opened was where a hydrant had been put in. Mr. Tanner said this portion, though included in the summons, had settled down properly. The Sessions Clerk remarked that if the Company were foolish enough to allow a contractor to interfere with their pipes, they must bear the consequences. Mr. Evans intimated that if the Bench decided against the Company, they would repair the road to the satisfaction of the County Surveyor. The Chairman (Mr. H. L. P. Lowe) said the Bench were unanimously of opinion that it was the duty of the Company to do the work, and that they were responsible. On Mr. Evans undertaking to put the road in repair within 14 days, only a nominal penalty of 1s., with 10s. 6d. costs, was inflicted.

Unlawfully Re-Connecting a Gas-Meter.

At the Bow Street Police Court last Thursday, Mr. T. Dudley, an Architect and Surveyor, of Lancaster Place, Strand, appeared before Sir J. Bridge, in answer to a summons charging him with a breach of the bye-laws of The Gaslight and Coke Company. Mr. H. Avory explained that the offence complained of was in contravention of section 64 of the Company's Act, which provided that before any person connected or disconnected a gas-meter with the Company's mains, he should give 24 hours' notice of his intention, or forfeit a sum not exceeding £5. The defendant had had his gas cut off no fewer than eight times in default of payment; and on one previous occasion he connected it again without giving notice. The Company, however, overlooked the offence. On the 6th of May last, the defendant's gas was again cut off; but on the 22nd of June it was discovered that the meter had been reconnected. This was a serious offence; and in similar cases people had been convicted of stealing the Company's gas. Evidence was called to show that when the gas at the defendant's place was last cut off, the meter showed a consumption of 11,100 cubic feet. When a meter inspector visited the premises on June 22, he found that a cap placed over the cut end of the service-pipe had been removed, and the pipe reconnected with the meter, which then registered 13,600 cubic feet. Mr. Johnson, on behalf of the defendant, said the Sheriff's officers were in possession of the premises. Everyone knew what they were like; and he suggested that they had connected the gas-pipes to enable them to smoke and keep warm. (Laughter.) Defendant was well known, and utterly incapable of committing the offence attributed to him. Sir John Bridge said it was evident the defendant must have known that the gas-pipes had been again connected, no matter by whom the work had been done. It was a serious offence; and he should fine the defendant £5, or, in default, 14 days' imprisonment.

Using Water for other than Domestic Purposes.

At the Bristol Police Court on the 5th inst., Frederick John Hawkes, of The Firs, Somerville Road, St. Andrew's, was summoned by the Bristol Water Company for, upon two occasions, using the water supplied by them for other than domestic purposes. Mr. C. J. C. Prichard, who appeared for the prosecutors, said defendant's house was supplied with water for domestic purposes, but not for watering the garden. On June 15 he was seen watering his garden with a hose, and also that of a next-door neighbour. Evidence was given in support of the case on June 15, and also with reference to a second occasion on June 27; the Company's officer stating that he did not warn defendant. His Honour Judge Austin said there was no reason why the defendant should not have been warned. It was quite possible that he was ignorant of the fact that he was committing any offence; and it was rather sharp practice to let him go on in his offence, and then "pull him up" for a second offence. The fine imposed would be 10s. and costs in the first case, and 1s. without costs in the second.

Brent Water Supply.—An inquiry was recently held by Colonel J. O. Hasted, on behalf of the Local Government Board, relative to an application by the Totnes Rural District Council for permission to borrow £850 for the improvement of the water supply of Brent. The question has been under consideration for some years. On a former occasion, the Rural Sanitary Authority sought powers to borrow £300 to bring in a stream of water; but the opposition was so great that the Local Government Board refused its sanction. It was now proposed to construct a reservoir of 5000 gallons capacity, and lay 4-inch mains from it to the village, a distance of 2280 yards. Mr. C. G. S. Acock, the Surveyor to the District Council, explained the scheme, and said the cost would be £813; and the result would be to just double the present summer supply. Opposition was offered on behalf of a majority of the Parish Council and a large number of ratepayers. The objections were that the supply, even if it doubled that now existing, would be insufficient; while the higher part of the district would be still, as now, without water.

MISCELLANEOUS NEWS.

METROPOLIS GAS SUPPLY.

Dr. Williamson's Quarterly Report.

The following is an extract from the report of Dr. A. W. Williamson, the Chief Gas Examiner for London, on the quality of the gas supplied to the Metropolis during the quarter ended the 30th of June, 1895:—

I. *With respect to Illuminating Power.*—The maximum, minimum, and average results, in standard sperm candles, at each of the testing-places, were as follows:—

Testing-Station.	Maximum.	Minimum.	Average.
The Gaslight and Coke Company—			
21, Millbank Street, S.W.	17·3	16·1	16·4
123, Ladbroke Grove, W.	16·8	16·2	16·4
11, Devon's Road, Bow.	(Closed.)		
1, Carlyle Square, Chelsea	16·7	16·0	16·2
170, Camden Street, N.W.	17·0	16·1	16·5
14A, Graham Road, Dalston	17·3	16·3	16·7
47, Kingsland Road, E.	17·8	16·2	16·8
Spring Gardens, Charing Cross	17·3	15·6	16·3
Grove Gardens, St. John's Wood	(Closed.)		
116, Lambeth Road, S.E.	16·8	16·0	16·1
121, Hornsey Road, N.	17·0	16·0	16·3
66, George Street, Hampstead Road	17·5	16·0	16·7
106, Fenchurch Street, E.C.	17·1	16·1	16·5
10, Kinghorn Street, Cloth Fair	17·0	15·8	16·4
1, Dorset Buildings, Salisbury Square	17·3	16·1	16·6
Commercial Company—			
6, Wellclose Square, E.	17·1	15·6	16·2
24, Parnell Road, E.	16·8	16·0	16·2
South Metropolitan Company—			
104, Hill Street, Peckham.	17·6	16·0	16·6
37, Bedford Road, Clapham	17·3	16·0	16·3
1, Stoney Lane, Tooley Street	17·6	16·1	16·7
180, Lewisham Road, S.E.	16·9	16·1	16·4
99, Blackfriars Road, S.E.	17·5	16·0	16·5
211, Burrage Road, S.E.	17·2	16·0	16·5

II. *As regards Purity.*—Sulphuretted hydrogen has not been present in the gas at any of the testing-stations. The proportions of sulphur in other forms than this were as follows:—

Grains of Sulphur per 100 Cubic Feet of Gas.

Testing-Station.	Maximum.	Minimum.	Average.
The Gaslight and Coke Company—			
21, Millbank Street, S.W.	8·5	4·9	7·0
123, Ladbroke Grove, W.	10·8	7·9	9·3
11, Devon's Road, Bow.	(Closed.)		
1, Carlyle Square, Chelsea	12·4	8·7	10·4
170, Camden Street, N.W.	13·5	9·0	11·9
14A, Graham Road, Dalston	15·5	10·0	12·2
47, Kingsland Road, E.	13·9	5·5	10·9
Spring Gardens, Charing Cross	11·3	4·1	6·9
Grove Gardens, St. John's Wood	(Closed.)		
116, Lambeth Road, S.E.	14·8	6·1	9·3
121, Hornsey Road, N.	12·2	8·5	10·2
66, George Street, Hampstead Road	16·7	8·8	12·0
106, Fenchurch Street, E.C.	17·9	8·0	11·7
10, Kinghorn Street, E.C.	13·0	8·7	10·4
1, Dorset Buildings, E.C.	12·3	7·3	10·3
Commercial Company—			
6, Wellclose Square, E.	10·3	4·1	6·2
24, Parnell Road, E.	8·5	4·4	6·0
South Metropolitan Company—			
104, Hill Street, Peckham	16·2	5·4	9·1
37, Bedford Road, Clapham	29·5	6·6	11·7
1, Stoney Lane, Tooley Street	15·7	6·3	9·2
180, Lewisham Road, S.E.	17·1	7·0	11·6
99, Blackfriars Road, S.E.	32·6	8·4	11·2
211, Burrage Road, S.E.	12·4	6·3	8·2

SOWERBY BRIDGE GAS UNDERTAKING.

Meter-Rents—The Extension of the Works.

At a recent meeting of the Gas Committee of the Sowerby Bridge District Council, it was decided to reduce the rents of two-light meters from 3s. to 2s. per annum; of three-light meters, from 4s. to 2s. 8d.; of five-light meters, from 5s. to 3s. 4d.; of ten-light meters, from 8s. to 5s. 4d.; and of twenty-light meters, from 12s. to 8s. It was further agreed that in future no more than 5 per cent. on the net cost be charged for the supply of new meters, the necessary connections, and fixing. On the same occasion, a letter was read from the Local Government Board in reference to the application of the Council for approval of the modified scheme for gas-works extension, requesting that the original sanction should be returned for cancellation, except as to the sum of £6409, the estimated expenditure on the modified scheme, and that a copy of the resolution of the Council directing the present application, together with an amended estimate embodying all the works which it is now proposed to carry out, be furnished to the Board. The Board also wished to know the age of No. 3 gasholder, and whether No. 2 holder was provided out of borrowed money. If so, when the loan was raised; and what amount, if any, was now outstanding. The Clerk was instructed to state that No. 3 holder was erected in 1879; and that No. 2 holder was provided out of revenue. Tenders for the erection of a third lift on No. 3 holder were afterwards considered; and it was decided to accept that of Messrs. Clayton, Son, and Co. On these minutes coming before the Council at their last meeting, Mr. J. Greenwood, alluding to the question of meter-rents, asked what the Committee were going to do with those consumers who had recently bought meters. He contended that anyone who intended buying a meter was at a very serious disadvantage to those who had already bought them. Anyone having bought a meter and wanting it repaired had to do it himself; and if the meter was taken back, a return was made upon it. During the past three years, the meters had had 12½ per cent. put on them; while those who had borrowed meters had nothing to pay. He urged that the meter buyer paid more than the meter borrower; and he considered it an injustice to the buyer, on whom 12½ per cent. was put, to lower the meter-rents, considering the small amount of gas which was consumed. The Chairman of the Gas Committee was not present to answer the question; but the Chairman of the Council said the Committee would leave as they were those persons who had purchased meters. The Committee did not think they had been unfairly dealt with in the past; and as the members were aware, those people who possessed meters were so few that there could be no injustice. The 12½ per cent. was what had been charged up to the present time. This had been running on for close upon 30 years; and hirers of meters had paid for them several times over. The percentage was now reduced to 8½. He moved the confirmation of the minutes, which was agreed to.

ELECTRIC LIGHTING NOTES.

The Eccles Town Council have been granted a twelvemonth's extension of the time in which, under the powers of their Provisional Order, they are to construct electric lighting works; and they have empowered their Electric Lighting Committee to incur the necessary expenditure for carrying out a scheme of lighting. The Electrical Engineer who has been consulted (Mr. Clirehugh) has projected works for public and private purposes which will involve a capital outlay of £18,971. His report is of a very sanguine character. He says that, if the Corporation adopt his proposal, there will be no charge on the rates, as, while the annual running expenses, including maintenance and machinery, interest on capital and payment to sinking fund, so as to pay off the loan in less than thirty years, would be £2066, the receipts would be £2590, or a surplus of £524. If the Council were to undertake the lighting of the street-lamps only, although the figures for capital outlay and annual cost would come up to not far short of the above figures, there would be a margin of saving (so Mr. Clirehugh says) as compared with the annual sum at present paid for the lighting of the street-lamps; the capital outlay being £15,000 in round figures, the annual cost £1560, as against an annual sum for gas lighting and other matters of £1690—leaving a margin in favour of electric lighting of £130, out of which, however, there would be a sum payable for rates and taxes.

The Tunbridge Wells Town Council are applying to the Local Government Board for sanction to borrow £12,000 for carrying out additional electric light works.

The Special Lighting Committee of the Liverpool Corporation have passed a resolution, recommending the Council to approve of an application to the Board of Trade for a Provisional Order, to enable them to supply electricity for public and private purposes "within the area of the city as the same may exist at the time of the granting of the Order."

The accounts of the first complete year's working of the Blackpool electricity undertaking have been presented to the Town Council. They exhibit a profit of £1604; the expenditure having been £3877, and the receipts £5481. The present output of current is all utilized; and the works are about to be extended. The Committee propose to acquire land between the electricity and gas works, and ultimately work the electric tramways from the same generating station.

At the meeting of the St. Pancras Vestry last Wednesday, Dr. J. Bell moved the adoption of a report of the Finance Committee recommending that £75,000 be borrowed from the National Bank, at 3 per cent. per annum, mainly for electricity purposes—repayment to be spread over a period of 42 years. It was explained that the total saving effected by obtaining the money from the bank instead of the London County Council would be £5626—the latter requiring 3¼ per cent. In regard to raising the loan by bonds issued by the Vestry itself, the Committee expressed the opinion that no advantage would result, and an initial cost of £500 would be incurred, as against £102 needed to effect the loan from the bank. Mr. E. Barnes moved, as an amendment, that the matter be referred back to the Committee. He maintained that, on the Vestry's own bonds, the money could be procured at 2½ per cent. Mr. Hodgson, in seconding the amendment, stated that the Corporation of York had recently secured a large sum on their own bonds at 2¾ per cent.; and he saw no reason why the St. Pancras Vestry should not be able to satisfy their financial needs at an equally cheap rate. Dr. Walter Smith advocated the consolidation of the whole of their debts and the issue of St. Pancras stock. Dr. Bell doubted whether the Vestry was a "corporate body" entitled to issue stock like a municipal corporation. The Chairman (Mr. J. Thornley, J.P.) stated that no Vestry in London had yet been able to borrow at 3 per cent. He incidentally mentioned that an additional loan to the extent of £100,000 would soon be needed for another electric installation. The original motion was carried by a large majority.

Prepayment Meters at Burslem.—The number of slot meters in use at Burslem is 600; and, according to a statement by Mr. Hulme at the last meeting of the Council, the price charged for gas through these meters is equally low with that supplied to the ordinary class of consumers.

Norwich Water Company.—The half-yearly accounts of this Company show that there is a sufficient balance in hand to pay a dividend at the rate of 6 per cent. per annum (deducting income-tax), and to carry forward £928. The late winter severely tried the resources of the Company; and at one period they sent into the City above 50 per cent. more water than the normal quantity. The Directors announce the death of their colleague, Mr. R. Fitch, who was until recently the Deputy-Chairman. The vacancy has been filled by the appointment of Mr. W. H. Black.

WATER-WORKS IMPROVEMENTS AT LEEDS.

The members of the Leeds Corporation yesterday week visited the city water-works in the Washburn Valley. Having reached Pateley Bridge by train, they drove to the head of the Washburn Valley, where they had an opportunity of inspecting the sites for the suggested two new storage reservoirs. The existing reservoirs have a capacity of 3907 million gallons; and the daily consumption in the city is about 24 millions. If, therefore, all the reservoirs were full, there would be sufficient water stored to supply the needs of the inhabitants for 163 days. But this is not considered sufficient, especially in view of the rapidly increasing consumption. A question, however, that is regarded still more seriously by the Corporation is the increasing expenditure incurred in furnishing an adequate supply of water to the higher districts of the city. Ten years ago a 100-horse power engine sufficed to do all the pumping required to get the water to the higher levels; but in the meantime these higher levels have been largely built upon. Thus, owing to the increased demand for water in these comparatively elevated districts, the cost of pumping has risen very considerably; and the Corporation are now confronted with the question whether they will be content to go on from time to time increasing their pumping power, or whether they will erect new storage reservoirs in the Washburn Valley at such an altitude that water could be supplied to the whole of Leeds (as it is at present to the lower portions) by simple gravitation. As to the matter of cost, the City Engineer (Mr. T. Hewson) is of opinion that, in a very short time, the annual cost of pumping will amount to more than would the interest on the capital necessary for the construction of the new reservoirs. The site for these reservoirs is at an altitude of about 800 feet, or over 200 feet above the present highest level of the Moortown and Bramley reservoirs; and there is a collecting ground of fully 4000 acres. After an hour's stay at the head of the Washburn Valley, the party were driven four or five miles farther down the valley to the Fewston and Swinsty reservoirs. Later on they proceeded to Harrogate, where dinner was served at the White Hart Hotel. In responding to the toast of his health, the Chairman of the Water Committee (Alderman Cooke) said the time had now fully arrived when active steps must be taken to secure a site for the future requirements of increased water supply, and to entirely abolish the costly process of pumping to the high-level districts. During the past year, there had been 5687 applications for new supplies of water. The total quantity of water supplied by meter for trade purposes in the city during the year was 1271 million gallons—an increase of 60 millions. The total consumption during the year had been 5,048,656,457 gallons—an average of 13,750,000 gallons per day. The renovation of the Eccup trench was proceeding very satisfactorily; the third and final section having been commenced. Plans were being prepared for new pumping-engines at Headingley; and the Committee were negotiating for the purchase of a site for a new service reservoir for Beeston.

THE SHEFFIELD CORPORATION AND THE LITTLE DON WATER SCHEME.

At the Monthly Meeting of the Sheffield City Council last Wednesday, the minutes of the Water Committee contained the following resolution: "That, as the Little Don portion of the Bill of the Dewsbury and Heckmondwike Water-Works Board has been rejected by the House of Lords, and the Bill of the Barnsley Corporation has not been passed by Parliament in this session, the Town Clerk be instructed to communicate to the Corporations of Rotherham and Doncaster that the Corporation of Sheffield are prepared to deposit and promote in the session of 1896 a Bill in accordance with the terms of the agreement of June 12, 1895,* between the three Corporations, for dealing with the whole watershed of the Little Don, for the supply of water in the manner, and for the purposes, set out in that agreement."

Alderman GAINSFORD, in moving the adoption of the minutes, said his motion involved the promotion of a Bill on the part of the Corporation, dealing with a probable expenditure of several hundred thousand pounds; and therefore he thought it was not right that he should simply in silence move a resolution of so much importance. The agreement of June 12 between the three Corporations of Sheffield, Rotherham, and Doncaster, settled the various conditions that should come into force if the Bills of the Dewsbury and Heckmondwike Board and the Barnsley Corporation were not passed by Parliament. The one had been, so far as the new works were concerned, rejected absolutely; and the other had not at any rate been passed by Parliament. The condition of things contemplated by the agreement had thus substantially come to pass; and it was proposed that the Council should now proceed to act according to the terms of the agreement that was sealed when they last met. If they did not do so, they would be taking a course that would be contrary both to the agreement and the interests of Sheffield. They needed for themselves the water of the Little Don Valley. They had been saying throughout, and would continue to say as long as there was any question raised about the matter, that Sheffield needed the water of the Little Don for herself. But, as he had freely stated, and as he thought the Council would agree, the requirements of Rotherham and Doncaster were very great, and had been proved to be great. The authorities of these places had applied to the Sheffield Corporation; but they could not supply Rotherham and Doncaster with any water whatever unless they had the control of, and parliamentary sanction for, the watershed of the Little Don. Therefore, as an absolute preliminary to their giving these towns the supply of water which they required, and the share of the water resources of the Don Valley which Sheffield had always admitted they had a natural right to, the Corporation must have parliamentary control over the whole of the watershed of the Little Don. It was simply to end the discussion that had taken place from time to time with regard to the ultimate destination of the waters of the Little Don Valley for a period of about thirty years, that they proposed to promote the Bill in Parliament. He thought there could be no question but that the proper destination of the water resources of the Little Don Valley was that which was set out in the agreement between the Corporations of Rotherham, Doncaster, and Sheffield. There was a way of using the waters without any waste for the benefit of the population in the valley. That, he said, was their proper destination, and that was the point which they proposed to submit to Parliament on behalf of the Corporation in the forthcoming session. The scheme which the Sheffield Corporation would probably be advised to deposit would be for two or more reservoirs, for utilizing the whole of the watershed. It was estimated that by the year 1931, Sheffield would not be satisfied with a quantity of water of less than 28 gallons per head per day, looking to the amount consumed in other towns, which was admitted in the Committee-room to be a reasonable figure. Between 1917 and 1918, there would be exhaustion of the existing and authorized works for Sheffield alone, which meant that the present power of supply was only a little over 13,000,000 gallons a day. Therefore at that period (when the quantity required would be 13,100,000 gallons a day) the works of the Corporation would be exhausted. If they decided that they were to give a supply to Rotherham and Doncaster out of existing resources to the extent that had been agreed upon—2,400,000 gallons per day—the whole of the Sheffield works would be exhausted, not in 1917, but in 1908. He was sure no one would contemplate that they should put themselves in such a position that their water supply would be exhausted at such an early date as that; and it was for this reason he remarked that, unless they obtained the powers proposed to be sought by the Bill, they could not afford to give Rotherham and Doncaster any supply of water whatever. He mentioned at the previous meeting of the Council the circumstance that the Barnsley Corporation proposed to take a portion of the water from the Little Don watershed, although they left a quantity of water unutilized. This took place at Ingbirchworth, on the Scout Dyke, which joined the Don at Penistone; and the Barnsley reservoir was not large enough to impound the waters that arose from the gathering-ground above this point. There was a quantity of water amounting to 700,000 gallons a day beyond what was or could be in the present condition of affairs drawn by Barnsley from the reservoir. The whole of the supply mentioned was not being utilized for any good purpose of water supply whatever. One of the points of the Corporation (and by no means the only one) in opposing the Barnsley authorities, was that before they had any shadow or ground whatever which would lead them to ask for water from anywhere else, they should make use of this 700,000 gallons per day of perfectly pure and good water arising from their own gathering-ground. It was suggested, in the course of the proceedings in London, that Sheffield was a very big and rich place—that it had better not talk about the small things, but leave them to the small corporations; and that it had better go farther afield, and make magnificent works like those of Manchester, Liverpool, Glasgow, and Birmingham. But to go farther afield would cost from 33 to 50 per cent. more per 1000 gallons than to take the water of the Little Don. Looking at the fact that the rates of Sheffield were already the highest of any town in the country, he was at a loss to understand what possible force there could be in the suggestion that Sheffield should deliberately give up water which was its natural heritage, and go farther afield, at a cost of some 50 per cent. more. That was a very good and sufficient answer, and one that they would not be afraid to submit in the proper place if occasion required.

The resolution was put, and carried without comment.

* See JOURNAL for June 18, p. 1329.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

At this period of political ferment, little attention is being paid to such prosaic subjects as are related to gas or water supplies; and consequently my "Notes" this week must be brief. Between gas supply and a parliamentary election, there is not so much affinity as there is when the election is a municipal one. Candidates therefore do not address themselves either specially to gas-workers or upon subjects connected with the gas industry. There was a notable, and a rather curious exception this week at Dundee, where two of the five candidates honoured the gas-workers with a special visit. Mr. John M'Crae was the natural chairman; and being in that position, he was able to take up the attitude of not indicating what his principles were. That was quite right; but I have not mentioned the curiosity of the business, which was that the first speaker, though soliciting parliamentary suffrages, devoted the whole of his time to a history of the gas undertakings, and their amalgamation when the community acquired them—a subject on which the workers might be expected to require no enlightenment, and upon which no amount of enlightenment would help them to discharge their duty at the polls. The incident is not worth following further in these pages; but it indicates very aptly how the roundest of men sometimes get into the squarest of holes, and points to the necessity there is, in public life, for the community not to accept everything that is uttered, but to exercise a critical judgment.

At the monthly meeting of the Perth Gas Commission this week, Mr. T. Whimster, the Engineer, reported that during the month of June the output of gas amounted to 3,398,200 cubic feet—an increase upon the output in June of last year of 292,200 cubic feet, which, in the dull season, shows how satisfactorily the gas consumption of Perth is rising. The yield, from coal and tar, was at the rate of 10,304 cubic feet per ton of coal carbonized. Using the Peebles oil process, the gas was enriched up to 27·40 candles.

The Dumfries Gas Commission have a balance at the credit of revenue for the past year of £515 8s.; and they have reduced the price of gas from 3s. 6d. to 3s. 4d. per 1000 cubic feet. A motion was made to the effect that the price of gas should remain at 3s. 6d., and that the 2d. should be applied to improving the quality; but only one man held the opinion that there was any necessity for improvement, and the

motion was not seconded. In 1878, when the Corporation acquired the gas undertaking, the price of gas was 5s. 10d. per 1000 cubic feet.

The Kirkcudbright Gas Commission, who have a mortgage debt over their works of £4300, had an income last year of £961, and an ordinary expenditure of £684; leaving £277 to meet interest. As, however, the amount required to do this was £297, there was a deficit of £19 15s.

It was reported to the Peterhead Town Council on Monday, that the output of gas during the last financial year amounted to 17,833,100 cubic feet—an increase of nearly 750,000 cubic feet over the output in the preceding year. The revenue from gas was £4159, as compared with £4339, which was accounted for by a reduction of 4d. per 1000 cubic feet of gas. The total revenue was £4575; and the ordinary expenditure, £2965. After paying interest on mortgages, &c., there was a surplus amounting to £618. Last year it was £596. A year ago, the estimate was for a surplus of £210, so that the expectation has been more than realized. For the current year, they have estimated a surplus of £392. The Commissioners again reduced the price of gas by 3d. per 1000 cubic feet, making it now 5s. 3d., which is equal to a reduction of 7d. in two years. This tells of excellent management; and it is gratifying to observe that the Town Council are conscious of the good services their Manager (Mr. J. Kincaid) is rendering them, as is shown in their advancing his salary by £20 a year.

During the five months in which they have owned the gas undertaking, the Falkirk Gas Commissioners have earned a profit of £198 on the working of the undertaking. That sum is to be carried forward. Nothing else could be done with it. It will doubtless be all required when the first annual balance is struck, for the formation of reserve or depreciation accounts, if for nothing else.

The Cupar Gas Company last year earned a profit of £965; and have paid dividends at the rate of 4 per cent. on the preference, and 7½ per cent. on the ordinary shares. A sum of £176 has been set aside for depreciation, and £100 has been added to the reserve fund; leaving £150 to be carried forward. The price of gas has been reduced from 4s. 7d. to 4s. 2d. per 1000 cubic feet. The shareholders, at their annual meeting on Thursday, resolved to have the Company registered as a limited liability one. It is evident that the Company, under the re-arrangements of two years ago, in which Mr. Adam Macpherson, of Kirkcaldy, took a leading part, have entered on a new lease of life.

The Denny Police Commissioners have an increasing business; the output of gas last month having been 8400 cubic feet more than in the corresponding month of last year. The Police Commissioners instructed the Gas Committee to consider as to what remuneration the Gas Manager and his assistants should receive for the extra work they did last winter on account of the frost. This is a sensible proceeding, which might be copied elsewhere.

The Bathgate Gas Company have closed a successful year; and have reduced the price of gas from 4s. 7d. to 4s. 5d. per 1000 cubic feet. Mr. R. Robertson, the Manager, who was President of the North British Association of Gas Managers when they met in Edinburgh in 1891, has been ill since the year began; but I am happy to say—and I am sure your readers will be glad to learn—that he is getting stronger daily, and is now, though still weak, able to attend to his duties.

The Irvine Gaslight Company had an income last year of £3100, and a sum available for dividend of £1129. The capital of the Company amounts to £8718, upon which a dividend at the rate of 10 per cent. has been paid. The price of gas has been continued at 3s. 9d. per 1000 cubic feet. A sum of £2359 has, in the last two years, been paid out of reserve fund for a new gasholder and tank; and the balance at the reserve fund is now £575.

Sulphate of ammonia is in less demand, which is quite natural, considering the season of the year. Few transactions are taking place; and the prices realized are slightly down—being £9 11s. 3d. per ton for spot delivery.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *July* 13.

Sulphate of Ammonia.—Throughout the week, the market has been quiet; and the tendency of prices has been in favour of buyers. Production is, of course, just now very limited. But demand, too, has been only moderate; and dealers' low quotations to consumers have had a damaging influence upon the market, so that, at the close, the quotation f.o.b. at the ports is £9 10s. to £9 12s. 6d. per ton. At about spot prices, there no doubt would be large buyers for forward delivery; but the figures are too low for even "bear" sellers to risk in the forward position; and makers will not look at them.

Nitrate of Soda remains quiet, at 8s. 3d. per cwt. for fine quality; and forward delivery is unchanged.

LONDON, *July* 13.

Tar Products.—With the exception of pitch, which keeps in fair demand, this market is as dull as it could well be. Benzols are flat and unsaleable; and while solvent naphtha is being delivered freely on contract, it is not easy to sell at full values for forward. The same remark applies to carbolic acid, which was readily sold a short time ago; but to-day the position is distinctly languid. Anthracene maintains the Product Committee's prices; but no business of importance is reported. Important tar contracts are said to have been let at prices ranging between 17s. 6d. and 21s. 9d., according to position and quality of tar. Other prices are: Pitch, 35s. to 37s. 6d.; Benzols, 90's, 1s.; 50's, 11½d. Solvent naphtha, 1s. 0½d. Toluol, 1s. 0½d. Crude, 30 per cent., naphtha, 4½d. Creosote, liquid, 1½d.; ordinary, ¾d.; salts, 18s. Cresylic acid, refined, 1s.; brown, 10½d. Carbolic acid, 60's, 1s. 5½d. Anthracene, nominal, "A," 1s. 1d.; "B," 10d.

Sulphate of Ammonia does not recover as it was hoped it would during the summer months. There is a distinct "bear" operation in this market; and dealers seem able to do as they like in the way of prices. But having regard to the nitrogen value of nitrate, sulphate certainly should be held. Transactions during the week have taken place at £9 10s. to £9 15s., less 3½ per cent. Gas liquor is quoted at 7s. to 8s.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—The only important gas-coal contract in this district now remaining to be settled is that of the Salford Corporation; and I was informed on 'Change that inquiries made by the representative of one colliery that had sent in tenders, elicited the fact that the contracts were not likely to be settled for several weeks to come. One or two similar contracts have been concluded during the last week or so; but prices have shown no appreciable variation from those I have already quoted—ranging from 6s. 6d. at the pit mouth for good qualities of screened four-feet, to 7s. for partially screened or through-and-through gas coal. Perhaps one of the most extraordinary features in connection with gas-coal contracts is that they should be made a matter of political controversy; but this has been the case with regard to the tender sent in by one large concern — the Chambers collieries—for the contract at Oldham. Of course, just now political excitement runs very high; and allegations have been freely made that the Chambers colliery tender has not been accepted because of political opposition in the Council. Placards have been posted about the town giving the names of the Conservative members who are in favour of accepting the tender, and the Liberal members who are against it, with the result (I am informed in a semi-official way) that the Chambers tender has been accepted, subject to subsequent confirmation by the Council. With regard to the round coal trade generally, business all through continues excessively quiet; and to avoid further accumulations of the already heavy stocks which are held at most of the collieries, the pits in a great many cases have not been running more than two or three days per week—four days representing about the full average anywhere. Where business of any weight is to be got hold of, prices are weak and irregular; representatives of collieries in most cases being ready with concessions upon the nominal list rates. At the pit mouth, best Wigan Arley coals are only fetching more than 10s. per ton in special cases for small lots; with second qualities and Pemberton four-feet averaging about 8s. 6d. to 9s.; and common coals ranging from 6s. to 6s. 6d. for steam and forge qualities, up to 7s. and 7s. 6d. for common house-fire descriptions. The excessive supplies of round coal now upon the market are naturally making themselves felt in the shipping trade, where rates are being cut lower than ever; and Yorkshire coal is coming into this district at prices which even Lancashire coalowners are not in a position to touch. Ordinary steam coal delivered at the ports on the Mersey can be bought readily at 7s. 3d. to 7s. 6d. per ton; and the very best qualities scarcely average more than 7s. 9d. Engine fuel moves off fairly well; but although the present output of slack is in most cases insufficient to meet the requirements of customers, there are large quantities held in stock which come upon the market at low figures, and prevent any upward move whatever. Good ordinary slack is readily obtainable at about 3s. 6d., and better qualities at about 4s. 6d. per ton at the pit mouth.

Northern Coal Trade.—There is an increased demand for coal, both of best steam qualities and of gas coal, during the last few days; but that for the latter is still a long way below the average consumption. Best Northumbrian steam coals are in good request for export; and the price is well maintained at 8s. 9d. to 8s. 10½d. per ton. Pits producing other kinds of steam coals are, however, only moderately at work. Steam small coals are quiet at from 3s. 3d. to 3s. 6d. per ton. For manufacturing coals there is only a moderate demand, with no alteration in price. Gas coals are in a little better request. Deliveries have now begun on a large number of contracts, the price of which ranges from equal to 6s. to 6s. 4d. per ton f.o.b. Sales of odd cargoes for shipment are at prices that vary more—from 6s. 3d. to 7s. per ton being quoted, according to the position of the collieries and the quality of the coal. Many of the coalowners, however, already complain of the prices they are receiving—prices which are scarcely likely to yield much profit; and though some concession in wages may be asked, any issue of such a request will be only doubtfully arrived at. Coke is on the whole steadier; the best Durham qualities being quoted at 13s. to 14s. per ton f.o.b. Exports are about up to the average, mainly to Spain and to the Baltic. There is no alteration in the price of gas coke this week; but the production is now naturally very small, though slightly increasing.

Scotch Coal Trade.—There is an absence of demand for all classes of coal which is giving some anxiety to owners, as this is a season—being immediately before the miners' holidays—when the demand always shows an improvement. For the next fortnight little work will be done in the pits; and in this way accumulations will be slightly reduced, but not much, as consumers of coal will also be largely on holiday. After the holidays, there must either be an improved demand or a lowering of prices, which would bring about trouble with the men; most probably it will be the former. The prices quoted are: Main, 5s. 9d. per ton f.o.b. Glasgow; ell, 6s. 9d. to 7s.; splint, 6s. 3d. to 6s. 6d.; and steam, 7s. 6d. to 7s. 9d. The shipments now compare with the attenuated figures during the miners' strike last year. For last week, the quantity shipped was 171,114 tons—an increase upon the quantity in the preceding week of 6312 tons, and of 143,857 tons upon the corresponding week of last year. For the year to date, the total quantity has been 3,458,589 tons—a decrease upon the quantity in the same period of last year of 161,951 tons.

New Joint-Stock Companies.—The Harrow Electric Light and Power Company has been registered with a capital of £25,000, in £5 shares, to take a transfer of all or any of the powers, duties, and liabilities by the Harrow Electric Lighting Order, 1894, granted to, and imposed upon, the undertakers therein mentioned, and to carry on business as suppliers of electricity at Harrow, Middlesex, or elsewhere. The Anglo-French Process Company, Limited, has been registered with a capital of £5000, to erect and maintain plant and apparatus for the manufacture of gas, and to carry on the business of a gas company. A Company has been formed in Brussels, with a capital of £40,000, for carrying out incandescent gas lighting on the Verstraeten system.

The Warwick Corporation and the Gas-Works.—The Warwick Gas Company having been approached upon the question of disposing of their property to the Corporation, the Directors have intimated to the latter that they are averse to the proposal, but they would be willing to consider any offer that might be made.

An Anomaly in Gas Supply at Newmilns, Ayrshire.—In the small weaving town of Newmilns, a few miles from Kilmarnock, there are, strange to relate, two Gas Companies; and yet the population of the area supplied is probably less than 4000. A few days ago the Directors of the two Companies held a joint meeting to consider the price of gas, with the result that they agreed to increase it ¼d. per 100 cubic feet, which will bring it up to 4s. 7d. per 1000 feet. Some definite line of action between the two Companies has also been resolved upon in regard to the discounts to be allowed to large consumers. Surely the anomaly of having two gas undertakings in so small a community is to be traced back to the Flintoff agitation of about forty years ago.

The Gas Industry at Saltcoats.—The quantity of gas made at Saltcoats, Ayrshire, last year was 12,756,300 cubic feet, as compared with 12,122,500 cubic feet in the preceding twelve months. It is said that the bulk of gas now produced per annum is exactly twice as large as it was in 1886-7. There is no change to report in the price of the gas, which remains at 3s. 9d. per 1000 cubic feet; the charge for street-lamps being two-thirds of that amount. The ordinary revenue of the Company in the past year was £2416; the expenditure, £1608. The quantity of coal used was 1328 tons; its average price being 10s. 10·11d. per ton. At the recent annual meeting of the Company, a dividend of 7½ per cent. was declared, as compared with 6¾ per cent. for 1893-4.

Yeovil Gas Company, Limited.—In the report of the Directors of this Company to be presented to the shareholders at the annual general meeting on the 29th inst., it is stated that the profit on the year's working, with the balance brought forward, amounts to £2779. Out of this an interim dividend of 5 per cent. was paid in February last, and the Directors recommend a further dividend of 5 per cent., free of income-tax. The Directors have reduced the price of gas by 2d. per 1000 cubic feet; bringing it down to 3s. 4d.; and a corresponding reduction has been made in the charge for street lighting. The works, under Mr. Edward Howell's management, have been maintained in good working order. The quantity of gas sold by meter (3,723,000 cubic feet) realized £5026; for public lighting (3,800,000 cubic feet), £738; and residuals produced £1280—the total revenue being £8629. A sum of £2664 was spent for coal and cannel (3325 tons); £816 for wages and salary; £682 for repairs and renewals of plant; and £227 for retorts and fire goods.

Eastern Counties Coal Boring and Development Association, Limited.—The first ordinary general meeting of this Association was held at Ipswich last Tuesday week—Mr. R. C. Rapier in the chair. The Directors reported that shares to the value of £4824 had been subscribed, and a site suitable for operations selected on the Suffolk side of the River Stour. A contract had been concluded with Vivian's Boring and Exploration Company, Limited; and work was commenced by them on Nov. 26 last. The chalk was reached at a depth of 72 feet from the surface; and the total depth bored to the 8th ult. was 938 feet. For 448 feet of this depth the work was of a very difficult character, owing to the great number of flints encountered. The borehole had passed 373 feet into the grey chalk. The Directors considered the rate of progress had, so far, been very satisfactory; and it was hoped that a few months more of steady work would carry the first hole to a sufficient depth. In moving the adoption of the report, the Chairman stated that Mr. Whittaker, F.G.S., one of the Consulting Geologists to the Association, had recently visited the boring, and had given very careful consideration to the results. In rendering assistance, Mr. Whittaker had the assent of the Geological Survey of England and Wales; and the officials were taking the liveliest interest in the Company's proceedings, and were perfectly willing to render all the help in their power. The only thing remaining was to persevere with the work; and so soon as the Directors had any satisfactory news to communicate to the shareholders, they would have very great pleasure in informing them thereon. The report was adopted.

European Gas Company, Limited.—The annual general meeting of this Company was held yesterday at the London Offices. The report which was submitted by the Directors mentioned that various unfavourable circumstances had prejudicially affected the business during the year, with the result that the aggregate rental at the seven stations showed a reduction of 1¾ per cent. Among the causes of this decrease was the early closing of shops in provincial towns during the severe weather in the month of February; and the Company had now, with one exception, to contend with the electric light at all the stations. The Directors had, in many cases, been able to meet this competition by incandescent gas-burners, and by making special concessions in price to large consumers. The number of consumers on the Company's books was stated to be constantly increasing; and the Directors were trying to extend the use of gas among small householders by introducing prepayment meters at three of their stations. At Nantes, the cost of coal had been enhanced by the increased dues levied by the Municipality. This increase, the report said, was a matter of considerable importance to the Company, as it represented an additional charge to the Nantes works of nearly £2000 per annum. Finding they could not come to an amicable arrangement with the Municipality, the Directors had reluctantly felt it incumbent upon them, in justice to the shareholders, to institute proceedings to have the question tested in a Court of Law. With reference to financial matters, the Directors had found it possible to reduce the amount hitherto set aside each year for the depreciation and redemption of capital, which would leave a larger amount of profit for distribution. In spite of the disadvantages under which the Company had laboured during the year, the usual dividend was recommended—viz., 20s. per share on the fully-paid shares, and 15s. per share on those on which £7 10s. had been paid (less the interim dividend of 8s. and 6s. per share respectively), and also the payment of a special bonus of 1 per cent. The report was adopted, on the motion of the Chairman (Mr. J. Blacket Gill), seconded by Mr. N. E. B. Garey. The Directors' statement, with a fuller report of the proceedings, will be published next week.

The Gas-Works Purchase Question at Ossett.—The Ossett Town Council yesterday week resolved to promote, in the next session of Parliament, a Bill enabling them to acquire the works of the Gas Company, and to establish an electric lighting plant.

The Ystrad Gas and Water Company have intimated to the Rhondda District Council that they are willing to sell their water undertaking at a fair value. The Directors aver that the statement recently made that they were unable and unwilling to supply a reasonable quantity of water is erroneous.

The Gas-Works Extensions at Bergen-op-Zoom.—In the JOURNAL for the 18th ult. (p. 1321) reference was made to the extensions which are to be carried out at the gas-works at Bergen-op-Zoom, in accordance with the plans and under the supervision of the Engineer (Herr Asselbergs). They comprise a two-lift gasholder of a capacity of 4000 cubic metres (about 150,000 cubic feet), which is to be completed before next winter. Eleven tenders have been sent in for this work from English and Continental firms. The highest was for 34,250 fl.; the lowest, for 26,000 fl. The latter offer was made by Herr F. A. Neuman, of Aken and Eschweiler; and it has been accepted. It includes all accessories and incidental expenses.

The New Water-Works for Mansfield.—Commenced some months ago, the new water-works of the Mansfield Corporation at Rainsworth have been pushed on with all possible speed; and, as we announced lately, a temporary supply has already been provided from the new source by means of a scheme suggested by the Engineer (Mr. G. Hodson) and the Chairman of the Water Committee (Alderman Barringer). The supply from this source amounts to about 300,000 gallons in 24 hours; while, in addition, there is a supply from the old works, which, however, can only be worked a few hours a day. When the permanent machinery is laid down, the yield from the new well will reach upwards of 900,000 gallons per day. The reservoir will have a storage capacity of 800,000 gallons; and the whole work is expected to be completed in about nine months. A few days since, the Town Council proceeded to the site of the works at Rainsworth in brakes, and witnessed the laying of the first stone by the Mayor (Alderman Alcock); and the event was celebrated in the evening by a dinner at the Town Hall.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 134.)

Issue.	Share	When ex-Dividend.	Interest or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.				£ s. d.
590,000	10	10 Apl.	10½	Alliance & Dublin 10 p. c.	10	22–23	..	4 11 4
100,000	10	,,	7½	Do. 7 p. c.	10	15–16	..	4 13 1
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	104–106	..	4 14 4
200,000	5	10 May	6½	Bombay, Limited	5	6¾–7¼	..	4 9 8
40,000	5	,,	6½	Do. New	4	5–5⅛	..	4 14 7
380,000	Stck.	28 Feb.	11½	Brentford Consolidated	100	250–255	..	4 10 2
180,000	,,	,,	8½	Do. New	100	200–205	..	4 2 11
220,000	Stck.	14 Mar.	11	Brighton & Hove Original	100	220–225	..	4 17 9
888,500	Stck.	28 Feb.	5	Bristol	100	122–125	..	4 0 0
320,000	20	28 Mar.	11½	British	20	53–54	..	4 3 4
50,000	10	14 Mar.	11½	Bromley, Ordinary 10 p. c.	10	22–23	..	4 7 0
51,510	10	,,	8½	Do. 7 p. c.	10	17–18	..	4 14 5
328,750	10	12 June	4	Buenos Ayres (New) Limited	10	7¼–8	..	5 0 0
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	99–102	..	5 17 8
150,000	20	11 July	8½	Cagliari, Limited	20	26–27*	..	6 2 3
550,000	Stck.	10 Apl.	13½	Commercial, Old Stock	100	292–297	..	4 10 10
165,000	,,	,,	10½	Do. New o.	100	225–230	..	4 11 4
160,762	,,	12 June	4½	Do. 4½ p. c. Deb. do.	100	143–147	+½	3 1 3
800,000	Stck.	12 June	13	Continental Union, Limited.	100	255–260	..	5 0 0
200,000	,,	,,	10	Do. 7 p. c. Pref.	100	203–208	..	4 16 2
535,000	Stck.	28 Feb.	5¼	Crystal Palace Ord. 5 p. c. Stk	100	125–130	+3	4 0 9
486,090	10	31 Jan.	11	European, Limited	10	24¼–25¼	..	4 6 3
354,060	10	,,	11	Do. Partly pa d	10	17–18	..	4 11 9
5,646,590	Stck.	14 Feb.	12	Gaslight & Coke, A, Ordinary	100	282–287	−3	4 3 7
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	105–110	..	3 12 9
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	280–285	+3	3 10 2
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	130–135	..	3 14 1
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	197–202	..	3 14 3
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	190–195	..	3 11 9
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	277–282	..	3 10 10
476,000	,,	,,	6	Do. K, 6 p. c. Prf..	100	165–170	..	3 10 7
1,061,150	,,	12 June	4	Do. 4 p. c. Deb. Stk.	100	130–133	+1	3 0 2
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	140–145	..	3 2 1
908,000	,,	,,	6	Do. 6 p. c. do.	100	198–202	+2½	2 19 4
3,800,000	Stck.	10 May	12	Imperial Continental	100	248–252	+½	4 15 3
75,000	5	26 June	6	Malta & Mediterranean, Ltd.	5	5½–6	..	5 0 0
560,000	100	1 Apl.	5	Met.of Melbourne, 5 p.c. Deb.	100	115–117	..	4 5 6
541,920	20	12 June	5	Monte Video, Limited	20	16–17	+½	5 17 8
150,000	5	24 May	8	Oriental, Limited	5	7–7½	..	5 6 8
60,000	5	28 Mar.	7	Ottoman, Limited	5	4¾–5¼	..	6 13 4
166,870	10	14 Feb.	2	Para, Limited	10	1¾–2¼	..	8 0 0
420,000	100	2 May	6	People's Gas of Chicago— 1st Mtg. Bds.	100	102–106	..	5 13 2
500,000	100	4 June	6	2nd Do.	100	100–105	..	5 14 3
150,000	10	26 Apl.	7	San Paulo, Limited	10	9–10	..	7 0 0
500,000	Stck.	14 Feb.	15½	South Metropolitan, A Stock	100	355–365	..	4 4 11
1,350,000	,,	,,	12	Do. B do.	100	302–307	+2	3 18 2
290,000	,,	,,	13	Do. C do.	100	307–312	..	4 3 4
775,000	,,	11 July	5	Do. 5 p. c. Deb. Stk.	100	172–176*	+4	2 16 10
60,000	Stck.	28 Feb.	11½	Tottenham & Edm'nton, "A"	100	230–235	..	4 17 10
				WATER COMPANIES.				
746,021	Stck.	26 June	10	Chelsea, Ordinary	100	290–295	..	3 7 10
1,719,514	Stck.	10 Apl.	8	East London, Ordinary	100	235–240	..	3 6 8
654,740	,,	26 June	4½	Do. 4½ p. c. Deb. Stk.	100	155–160	+3	2 16 3
700,000	50	26 June	7	Grand Junction	50	113–117	..	2 19 10
708,000	Stck.	14 Feb.	12	Kent	100	307–312	..	3 16 11
1,043,800	100	26 June	7½	Lambeth, 10 p. c. max.	100	258–263	+3	2 17 0
406,200	100	,,	7½	Do. 7½ p. c. max.	100	207–212	+2	3 10 9
330,000	Stck.	28 Mar.	4	Do. 4 p. c. Deb. Stk.	100	145–150	+6	2 13 4
500,000	100	14 Feb.	12½	New River, New Shares	100	375–385	..	3 6 2
1,000,000	Stck.	31 Jan.	4	Do. 4 p. c. Deb. Stk.	100	145–150	+4½	2 13 4
902,300	Stck.	12 June	4	S'thwk & V'xhall, 10 p.c. max.	100	157–163	..	2 9 1
126,500	100	,,	4	Do. D 7½ p.c. do.	100	135–140	..	2 17 2
1,155,066	Stck.	12 June	10	West Middlesex	100	288–293	+3	3 8 3

*Ex div.

GWYNNE & BEALE'S
PATENT GAS EXHAUSTERS AND ENGINES.

Telegrams: "GWYNNEGRAM, LONDON." Telephone No. 2698.

GWYNNE & CO.,

HYDRAULIC AND GAS ENGINEERS,

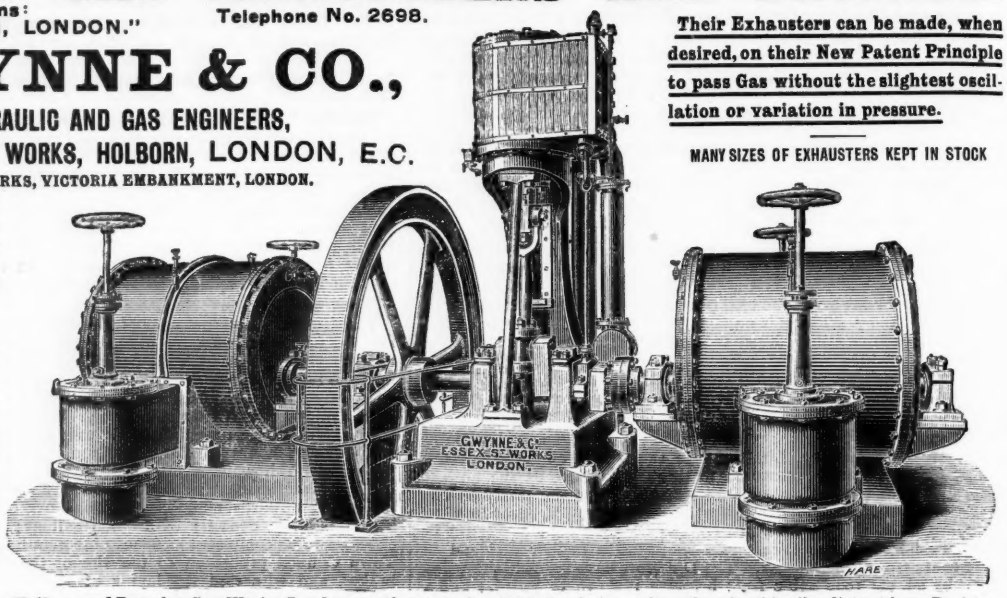
BROOKE STREET WORKS, HOLBORN, LONDON, E.C.

Late ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON.

They have completed Exhausters to the extent of 32,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work.

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS, PATENT RETORT-LIDS, STEAM-PUMPS for Tar, Liquor, or Water; CENTRIFUGAL PUMPS and PUMPING ENGINES, specially adapted for Water-Works, raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.



Their Exhausters can be made, when desired, on their New Patent Principle to pass Gas without the slightest oscillation or variation in pressure.

MANY SIZES OF EXHAUSTERS KEPT IN STOCK

Exhausting Machinery at Fulham and Bromley Gas-Works, London—each set passing 400,000 cub. ft. per hour drawing 14 miles distant from Beckton.

Catalogues and Testimonials sent on application.

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS, should be received not later than the FIRST POST on SATURDAY.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.

JOHN WM. O'NEILL, Managing Director, Palmerston Buildings, Old Broad Street, London, E.C.

ANDREW STEPHENSON, AGENT. All communications *re* Oxide to be addressed to Palmerston Buildings.

WINKELMANN'S "VOLCANIC" CEMENT. Fire Resistance up to 4500° Fahr. In use in most Continental Gas-Works, and in more than 300 British Gas-Works.

ANDREW STEPHENSON, 182, GRESHAM HOUSE, OLD BROAD STREET, LONDON, E.C.

Telegrams: "Volcanism, London."

AMMONIACAL LIQUOR Wanted.

BROTHERTON AND CO., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

GAS TAR Wanted.

BROTHERTON AND CO., Tar Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SPENT OXIDE Wanted.

BROTHERTON AND CO., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

BROTHERTON & CO.

Offices: Commercial Buildings, LEEDS. Correspondence invited.

GOLD MEDAL, 1892.

TUBES and Fittings for Gas, Steam, and Water, in stock to 8 inches diameter; Iron and Steel Ascension-Pipes.

JOHN SPENCER, Globe Tube Works, WEDNESBURY; and 14, Great St. Thomas Apostle, LONDON.

HUTCHINSON BROTHERS, Gas Engineers, &c., Falcon Works, Barnsley, Makers of Wet and Dry Gas-Meters, Brass-Work, and general Gas Apparatus, Lead Saturators, Tanks, &c., Tools, and Gas-Works Sundries. (See last week, p. 104.)

Telegrams: "HUTCHINSON BROS., BARNSLEY."

BACK-PRESSURE IN PURIFIERS.

THE Valve invented by Mr. Cripps for Bye-Passing any Layer of Purifying Material (referred to by the President of the Incorporated Institution of Gas Engineers in his Inaugural Address) can be obtained of the Makers: C. & W. WALKER, Midland Iron-Works, Donnington, near Newport, SALOP, and J. EVERY & SON, Phœnix Iron-Works, LEWES, to which Firms all inquiries should be addressed.

W. C. HOLMES & CO., Huddersfield; AND 80, CANNON STREET, LONDON, Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also Improved Patent Rotary Scrubber-Washers.

*** See Advertisement p. II., centre of JOURNAL.

Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.

First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.

Telegraphic Address: "Braddock Oldham."

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

SPECIAL PAINT FOR GAS-WORKS.

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JOHN E. WILLIAMS AND CO., VICTORIA PAINT WORKS, MANCHESTER.

For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

AMMONIA SATURATORS.

WALTER THOMASON and SONS, Chemical Plumbers, &c., and Makers of Lead Saturators, &c., 21, WESTON STREET, BOLTON. Repairs of every description.

Please write for Estimate before ordering elsewhere.

PATENTS FOR INVENTIONS.

J. C. CHAPMAN, M.I.M.E. and Fel. Chartered Inst. Patent Agents. ADVICE ON ALL MATTERS CONNECTED WITH ABOVE. Information and Handbook on application.

70, CHANCERY LANE, LONDON, W.C.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 315, St. Vincent Street, GLASGOW; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.

Head Office MIDDLESBROUGH. Correspondence invited.

GAS PURIFICATION.

OXIDE OF IRON BOG ORE.

BALE & CO.'S Oxide of uniform quality. Sample and Price on application.

OXIDE PAINTS, OILS, SULPHURIC ACID, &c. 120 and 121, NEWGATE STREET, LONDON, E.C.

Telegrams: "BOGORE, LONDON."

OXIDE OF IRON.

FINEST Quality of Natural Bog Ore. Particulars and price, apply to Mr. T. L. ARCHER, 20, Fennel Street, MANCHESTER.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for, Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.

Telegraphic Address: "PORTER LINCOLN."

HYDRATED OXIDE OF IRON.

PREPARED from pure Iron.
Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.

READ HOLLIDAY AND SONS, LIMITED, HUDDERSFIELD.

THE Undersigned is in a position to supply, at the very lowest Prices, the most suitable kind of BENZOL for enriching Gas, made from Hardman's Patent Carbonization Process, of which I am the Sole Patentee. On application, I would furnish Price on the most reasonable terms; giving advice how to utilize it on the most economical method.

J. HARDMAN, Manufacturing Chemist. Milton, Staffs.

In Paper Covers, Post Free 2s.

STEPHEN CARPENTER, of the Bow Common Gas-Works, on the Purification of Coal Gas by Lime, Oxide of Iron, and Atmospheric Air, and the Method of Working Purifiers so that the Lime may be used a second time, with a description of Carpenter's short Method of working off the Sulphur Test and Table for calculating Results.

S. & H. W. CARPENTER, 3, Bedford Villas, Carshalton SURREY.

WANTED, a Situation as Blacksmith, MAIN and SERVICE LAYER, &c.; Good References.

Address GEO. F. SMITH, 7, Myrtle Cottages, Shakespear Road, Romford, ESSEX.

SITUATION wanted by a Man who thoroughly understands Gas-Works. Also Boiler and Engine work. About Eleven years in present place. Married; Age 40; Good References.

ELDERFIELD, Stoke Court, STOKE POGES.

ADVERTISER desires position on large Gas-Works. Good Draughtsman, Chemist, and Accountant. Honours and Silver Medal "Gas Manufacture" Examination. Seven years' experience. Highest References.
Address No. 2545, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Working Foreman for Gas and Water Works.
Apply, stating terms, to GEO. E. WOODFORD, RUABON.

WANTED, a Man for small Gas-Works. One who also understands Boiler work. Single Man preferred.
Applications to C. LUCEY, Stoke Court, STOKE POGES.

METER REPAIRER.

WANTED, at the Stafford Gas-Works, a thoroughly good Man who can repair Wet and Dry Gas-Meters.
Apply, stating wages required, &c., to the ENGINEER, Gas-Works, STAFFORD.

WANTED, a young Man as Gas-Fitter and SERVICE LAYER. Must be competent to fix Meters, Stoves, and do inside Gas-Fitting in connection with Slot Meters.
Apply, stating Age, Experience, and Wages required to J. H. TROUGHTON, Manager, Gas-Works, NEWMARKET.

GRANTHAM GAS COMPANY.

THE Directors invite applications for the post of MANAGER. Must be experienced in Carbonizing, efficient in the control of Men, and with a good knowledge of Book-keeping.
Salary £300 a year, with good Residence and Garden, Rates, Gas, and Coal free.
Applications, stating age, accompanied by recent Testimonials (not more than three in number), to be sent in, addressed to the Chairman of the Company, not later than Tuesday, the 23rd of July, 1895.

MERTHYR TYDFIL GAS COMPANY.

WANTED, an active and efficient COLLECTOR of the Gas-Rents and other Accounts of this Company. Persons who have been already employed in similar duties, and possessing a knowledge of the routine of a Gas Office, preferred.
Candidates must not exceed 35 years of age.
Approved security for faithful services will be required.
Salary, £110 per annum.
Applications, stating Age, Experience, if Married or Single, and giving full particulars of past and present Engagements, accompanied by *copies only* of not more than three recent Testimonials of general character, to be addressed to the undersigned not later than Saturday, the 27th inst.

By order of the Directors,
JOHN LEES COCKER,
Manager and Secretary.

Gas Offices, Gas-Works, Merthyr Tydfil, Glamorganshire, July 10, 1895.

GAS Producer for Sale (Wilson type), 8 feet diameter by 13 feet high, with Körting Jet Blowers. All in first-class condition. Price £25. Can be seen in London at any time by appointment.
Address W. W., care of R. F. White and Son, 33, Fleet Street, LONDON, E.C.

WANTED, Spent Oxide for prompt delivery, any quantity, containing not less than 50 per cent. Sulphur.
Apply J. HARDMAN, Milton, STAFFS.

BOROUGH OF ILKESTON.
(GAS DEPARTMENT.)

TENDERS FOR GAS COAL.

TENDERS are invited for the supply of from 1000 to 5500 Tons of GAS COAL for the Year ending July 31, 1896.
Tender Forms to be had on application at the Gas Office, and to be returned, duly endorsed, not later than Noon, July 22, 1895, addressed to Wright Lissett, Esq., Town Clerk, Ilkeston.
The lowest or any tender not necessarily accepted.

F. C. HUMPHRYS,
Engineer and Manager.

TENDERS FOR TAR.

TENDERS are also invited for the sur- plus TAR produced at the Ilkeston Gas-Works for One Year.
The highest or any tender not necessarily accepted.
Forms of Tender and all Information on application to

F. C. HUMPHRYS,
Engineer and Manager.

Gas-Works, Ilkeston, July 4, 1895.

CORPORATION OF LANCASTER.
(GAS DEPARTMENT.)

TENDERS FOR GAS COAL.

THE Gas Committee are prepared to receive TENDERS for the supply of screened GAS COAL, delivered on the Gas-Works Siding, Lancaster, in such quantities and at such times as may be required during a period of One, Two, or Three Years, commencing delivery Sept. 1 next.
Sealed tenders, endorsed "Gas Coal," giving full particulars of the Coal offered, must be delivered to W. O. Roper, Esq., Town Clerk, Lancaster, on or before the 22nd day of July.
Forms of Tender may be obtained on application to the undersigned.
The lowest or any tender not necessarily accepted.

C. ARMITAGE.

Gas-Works, Lancaster, July 1, 1895.

STRATFORD-ON-AVON CORPORATION.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the supply of 4000 Tons of best quality of GAS COALS.
Forms of Tender and full Particulars may be obtained of

J. S. CRANMER,
July, 1895. Manager.

TENDERS FOR COAL.

THE Eccleshill and Bolton Gas Com- pany invite TENDERS for 1500 to 2000 Tons of GAS COAL, to be delivered at the Railway Station (G.N.R.) in Twelve Months, in such quantities, from time to time, as may be required.
Endorsed tenders must reach me not later than the 22nd inst.

J. MELLOR,
Secretary.

Eccleshill, Bradford, July 12, 1895.

TAR AND LIQUOR.

THE Eccleshill and Bolton Gas Com- pany invite TENDERS for the surplus TAR and AMMONIACAL LIQUOR to be produced at their Works, together or separately, for Twelve Months, from the 1st of September next. Can be delivered in Contractors' Tanks at the Station (G.N.R.).
Coal carbonized per annum, about 2000 Tons.
Tenders, sealed and endorsed, must reach me not later than the 25th inst.

J. MELLOR,
Secretary.

Eccleshill, Bradford, July 12, 1895.

BETHESDA.

THE Bethesda Urban District Council invite TENDERS for the purchase of the surplus TAR at their Works (about 30 Tons).
The highest or any Tender will not necessarily be accepted.

R. BENJAMIN EVANS,
Clerk to the Council.

Bronarfon, Llanllechid, Near Bangor, July 11, 1895.

BETHESDA.

THE Bethesda Urban District Council invite TENDERS for the supply of GAS COAL for a period of One Year, commencing from the 1st day of August, 1895, to the 31st day of July, 1896, to be delivered at the Bethesda Railway Station in such quantity and at such times as may be required.
The Coal must be of the best of its kind, well screened, and free from Bats, Pyrites, or other impurities.
Parties tendering must give full information as to the Coal offered, and the Colliery from which they propose to supply. The tenders to be sent to me not later than the 22nd day of July, 1895.
The Commissioners do not bind themselves to accept the lowest or any tender.

R. BENJAMIN EVANS,
Clerk to the Council.

Bronarfon, Llanllechid, Near Bangor, July 11, 1895.

OSWALDTWISTLE URBAN DISTRICT COUNCIL.

THE Gas Committee invite Tenders for the TAR and LIQUOR produced at their Works for One Year from the 31st day of July, 1895.
The quantity of Coal carbonized is about 3500 Tons.
Further Particulars may be obtained from the Manager, Gas-Works, Church, near Accrington.
Tenders, endorsed "Tender for Tar," to be addressed to me, and to be delivered not later than Wednesday, the 31st of July.

WM. SANDEMAN,
Clerk.

District Council Offices, Oswaldtwistle, June 26, 1895.

BOROUGH OF ROCHDALE.

TO CHEMICAL MANUFACTURERS.

THE Gas Committee of the Corporation invite TENDERS for the supply of such quantities of BROWN OIL OF VITRIOL as they may require during the ensuing Twelve Months. The Acid to be made from Pyrites or Recovered Sulphur, and to be delivered at the Rochdale Railway Station.
Further Information can be obtained from Mr. T. B. Ball, the Manager at the Gas-Works.
Tenders, endorsed "Vitriol," must be sent to me not later than Noon of Wednesday, the 24th inst.

By order,
JAMES LEACH,
Deputy Town Clerk.

Town Hall, Rochdale, July 13, 1895.

BOROUGH OF BRIGHOUSE.

TENDERS FOR GAS COAL.

THE Gas Committee are prepared to receive TENDERS for the supply and delivery of about 4000 Tons of GAS COAL required at their Rastrick Gas-Works, Bird Royd, from Aug. 1, 1895, to June 30, 1896.
Specification and Form of Tender can be obtained on application at the Gas Engineer's Office, Public Offices, Brighouse.
Sealed tenders, stating price per ton delivered at the Gas-Works, or alongside Gas-Works by the Calder and Hebble Canal, or at Brighouse Railway Station, must be sent in on or before Wednesday, the 31st day of July, 1895, addressed to the Town Clerk, Public Offices, Brighouse, endorsed on the outside "Tender for Coal."
The lowest or any tender not necessarily accepted.

By order,
JAMES PARKINSON,
Town Clerk.

Public Offices, Brighouse, July 10, 1895.

LINCOLN CORPORATION.
(GAS DEPARTMENT.)

TENDERS FOR TAR.

THE Gas Committee of the Corporation of Lincoln are prepared to receive TENDERS for the purchase of the surplus TAR (about 800 Tons) produced at their Works during the period of One Year, commencing on the 1st of July, 1895.
Sealed tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Residuals," must be delivered at the Gas Offices, Lincoln, on or before the 29th inst.
The Committee do not bind themselves to accept the highest or any tender.
Other Particulars may be obtained of the undersigned.

JNO. CARTER,
Manager.

Gas-Works, Lincoln, July 6, 1895.

CITY OF HEREFORD.

THE Gas Management Committee of the Corporation invite TENDERS for the supply of best screened large GAS COAL, for One Year, from the 1st of August next, to be delivered free at the Gas-Works Siding, Hereford, in such quantities as may be required from time to time.
The estimated quantity required will be about 8000 Tons.
Full Particulars and printed Forms of Tender may be obtained on application to the undersigned.
Tenders, endorsed "Tender for Gas Coal," are to be sent in addressed to the Chairman, Gas Management Committee, Mansion House, Hereford, by Saturday, July 20.
The Committee do not bind themselves to accept th lowest or any tender.

By order,
WILLIAM PARLBY,
Gas Engineer and Manager.

Gas-Works, Hereford, July 8, 1895.

TENDERS FOR TAR AND LIQUOR.

THE Directors of the Slough Gas and Coke Company are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR (or either) produced at their Works, for a term of One Year, from the 30th of June, 1895.
The Slough Branch of the Grand Junction Canal is available.
The estimated quantities to be produced are: Tar, 30,000 Gallons; and Liquor, 30,000 Gallons.
The Products must be removed from the Works in Tank Carts.
Sealed tenders, stating price for Tar per Barrel of 36 Gallons, and prices for Ammoniacal Liquor per 1000 Gallons of different strengths, at the Company's Works, and endorsed "Tender for Tar and Liquor," to be delivered on or before Tuesday, the 23rd of July inst.
The Directors do not bind themselves to accept the highest or any tender.

ARTHUR THOMAS,
Secretary.

S'ough, Bucks, July 11, 1895.

BY ORDER OF EXECUTORS AND OTHERS.

GAS AND WATER SHARES AND STOCKS.

MR. ALFRED RICHARDS will Sell by AUCTION at the Mart, E.C., on Tuesday, July 30, at Two, in Lots, 61 £10 fully-paid SHARES in the UXBRIDGE and HILLINGDON GAS CONSUMERS' COMPANY; also £352 MORTGAGE DEBENTURE BONDS in the SOUTH-WEST SUBURBAN WATER COMPANY, LIMITED.
Particulars of Messrs. HORSLEY AND WEIGHTMAN, Solicitors, 1, GUILDHALL CHAMBERS, E.C., and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

NOTICE.

TO GAS ENGINEERS AND OTHERS.

MESSRS. CLAPHAM BROS., Limited, Keighley, Yorkshire, are no longer authorized to Manufacture my CONDENSER and WASHER-SCRUBBERS.
The above-named Gas Apparatus are erected and giving entire satisfaction at the following places: Neath, Lincoln, Sheffield, Ellesmere, Mountain Ash, Malden, Cullingworth, Montreal (Canada), Woodstock (South Africa), Cape Town (South Africa), &c.
These Appliances can now be obtained solely of the undersigned.
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NOTICES FOR POSTING IN GAS-WORKS.

CARDS suitable for Exhibiting in Gas- Works, directing Officers and Workmen to REPORT all ACCIDENTS witnessed by them, together with the Clause of the "NOTICE OF ACCIDENTS ACT, 1894," specifying the notice required to be sent to the Board of Trade, can be obtained, *price 4d. each, or 2s. 6d. per dozen, post free.*
Section 4 of the "CONSPIRACY AND PROTECTION OF PROPERTY ACT, 1875," has been similarly printed. It is required, under a Penalty of FIVE POUNDS, that a Copy of the Section shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by persons employed thereat. Copies, in large type, on broad sheets (22½ inches by 17½ inches) may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C. *Price 2s. per dozen; 10s. 6d. per 100.* On Cards the same size as those relating to the "Notice of Accidents Act," *price 4d. each or 2s. 6d. per dozen.*

"BEAR CREEK" CANNEL.

LOG MOUNTAIN COAL, COKE, AND TIMBER CO.,
PINEVILLE, KENTUCKY, U.S.A.
Cable Address: "Hull, Pineville."

LONDON AGENTS:
W. J. WILSON & Co., Suffolk House, Cannon St., E.C.

NOTICE.

The Incandescent Gas-Light Company, Limited, Hereby Give Notice, that they only supply their Mantles subject to the following express Conditions, which are printed and pasted on each box:—

"The Incandescent Gas-Light Company, Limited, in supplying the Mantle contained in this box, grant a Limited License to the purchaser to sell or use the same on the express condition that neither the purchaser nor any other person into whose hands the same may come shall use or sell the said Mantle except in connection, or for use, with Burners sold or supplied by the Company; any other sale or use will amount to Infringement of the Company's Patents. The Company supply Mantles for the purpose of renewals at the nominal price of 1s. 3d., subject to the Conditions and Limitations above set forth."

In the case of *The Incandescent Gas-Light Company, Limited v. Cantelo,* **Mr. Justice Wills upheld the Validity of these Conditions and Limited License; and, in the course of his Judgment, said:—**

"The patentee has the sole right of using and selling the articles; and he may prevent anybody from dealing with them at all. Inasmuch as he has the right to prevent people from using them or dealing in them at all, he has the right to do the lesser thing—that is to say, to impose his own conditions. It does not matter how unreasonable or how absurd the conditions are. It does not matter what they are if he says at the time when the purchaser proposes to buy, or the person proposes to take a license: 'Mind I only give you this license on this condition;' and the purchaser is free to leave it or take it as he likes. If he takes it, he must be bound by the condition."

In the case of *The Incandescent Gas-Light Company v. Hirschfeld and Others,* **the Honourable Mr. Justice Romer certified that the Validity of the Plaintiffs' Patents was established. Infringers in future will be liable to costs as between Solicitor and Client.**

(Signed) **FAITHFULL & OWEN,**
Solicitors for the Incandescent Gas-Light Company, Limited.

TO EMPLOYERS, COMPANY DIRECTORS, ETC.

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NATURAL IRISH BOG ORE.

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Samples and Prices on application.

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Telegrams: "HUNTER, PORT GLASGOW."

Established 1872.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS:—

Yield of Gas Per Ton . . 11,205 Cubic Feet.
Illuminating Power, $16\frac{7}{10}$ Stand. Sperm. Candl.
Coke (of good & pure quality) $13\frac{3}{4}$ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE, 2500 TONS.

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Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . $13\frac{1}{2}$ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar . . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor $94\frac{1}{2}$ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

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Gas per Ton . . . 15,100 Cub. Ft.
Illuminating Power . 45·6 Candles.

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BLACK BED GAS COAL.

Prices and Analysis on application.

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RAVENSTHORPE, NEAR DEWSBURY.

ECONOMIZE £16 per RETORT per ANNUM by the USE of RETORTS of REDUCED THICKNESS fitted with

GUEGUEN'S
COMPENSATING HELICOIDAL RIBS.

NO OUTLAY OF CAPITAL.
NO ALTERATION IN SETTINGS.
APPLICABLE TO ALL RETORTS

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Engineer,
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Inquiries from Retort Makers will be Esteemed.

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OUGHTIBRIDGE, near SHEFFIELD
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

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THE "COLIGNY" LAMP

FOR LIGHTING RAILWAY CARRIAGES WITH GAS.

It having come to our knowledge that certain **IMITATIONS** of our **PATENT REGENERATIVE GAS ROOF LAMP** are being offered for Sale, we hereby give notice that it is our intention to take **LEGAL PROCEEDINGS** against any Person or Persons making Lamps which are Infringements of such Patents.

THE LAMP MANUFACTURING COMPANY, LTD.,
12 & 14, Leonard Street,
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July 8, 1895.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

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COKE-BREAKERS,

PRICES REDUCED.
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New Design, with two Cutting Rollers, making less Breeze than their old pattern.

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We have erected, and are erecting, a number of the most complete
AUTOMATIC COAL AND COKE HANDLING PLANTS
In the World.

☛ We are now engaged erecting a plant to distribute the Coal into 375 Coke-Ovens, each 30 feet long, and convey the HOT Coke on an improved Conveyor to the Blast-Furnaces. We have also on order six Plants to elevate and convey from 200 to 2000 Tons of Coal per day. For the latter, we are supplying three Conveyors, each 72 inches wide, with Cast Steel Chain Elevators and Accessories to suit.

Address:—
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BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.
Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to
The Gaslight and Coke Company, South Metropolitan Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Bombay Gas Company, San Paulo Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the
HARTON COAL COMPANY, LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON, FITTER.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for
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TYNE
BOGHEAD CANNEL.

Yield of Gas per ton . . . . . 13,155 cub. ft.
Illuminating Power . . . . . 38·22 candles.
Coke per ton . . . . . 1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 73·1 per cent.

For Prices and complete Analysis, apply to
THOS. W. DANCE & SONS,
COAL OWNERS, NEWCASTLE-ON-TYNE;
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E. FOSTER & CO.,
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YIELD OF GAS PER TON . 10,375 CUBIC FEET.
ILLUMINATING POWER . 17·50 SPERM CANDLES.
COKE. . . . . 75 PER CENT.

Prices, f.o.r. or f.o.b., on application to
GEORGE & JOHN HAIGH,
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A TRIAL IS RESPECTFULLY SOLICITED.

PIPES, 2-in. to 8-in. PIPES, 2-in. to 8-in. PIPES.

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MIDDLESBROUGH.

KENT'S THICK GAS COAL

RAISED AT
The Wharncliffe Woodmoor Colliery,
BARNSLEY.

Yield of Gas, nearly 12,000 *Cubic Feet per ton of Coal; and Illuminating Power nearly* 17½ *Candles.*

The following is a complete ANALYSIS made by Mr. R. O. PATERSON, C.E., Gas-Works, Cheltenham:—

Specific Gravity (Water 1). .	1·276
Weight of One Cubic Foot. .	79·700 lbs.

PROXIMATE ANALYSIS.

Moisture in Coal	2·68 per cent.
Volatile Matter.	35·60 ,,
Fixed Carbon	58·80 ,,
Sulphur	0·96 ,,
Ash.	1·96 ,,

COMMERCIAL ANALYSIS.

Gas per Ton of Coal	11,760 cub. feet.
Gas per Cubic Foot of Coal .	418 ,,
Illuminating Power	17·44 candles.
Value of One Cubic Foot in Sperm	418 grains.
Value per Ton of Coal in Sperm	703 lbs.
Coke per Ton of Coal . . .	1367 ,,
Coke	61·05 per cent.
Ash in Coke	3·21 ,,
Sulphur Eliminated with Volatile Products per Ton of Coal	9·4 lbs.
Sulphur in Coke per Ton of Coal	12 ,,
Ammoniacal Liquor per Ton of Coal	19·7 galls.
Tar per Ton of Coal	12·2 ,,

R. O. PATERSON, C.E.
Gas-Works, Cheltenham,
8th August, 1894.

For Price, &c., apply to the
Wharncliffe Woodmoor Colliery Co LIMITED,
BARNSLEY;
Or to Mr. W. H. HARVEY,
17, Old Queen Street, Westminster, S.W.

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

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Highest Results in Gas, & Excellent Coke.

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RETORT SETTING
MAIN LAYING

PLANS & ESTIMATES ON APPLICATION.

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Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY,
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON & COAL Co. Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by

Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

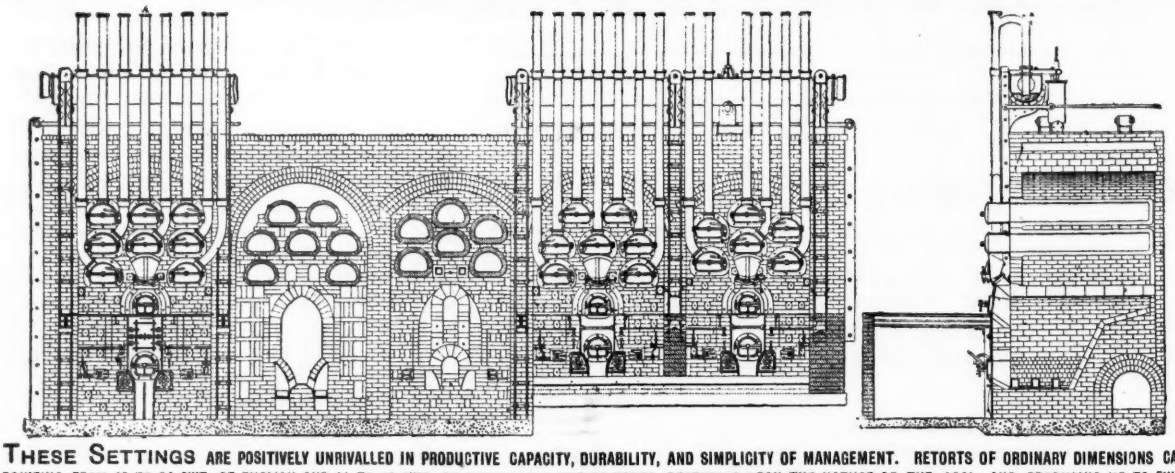
Yield of Gas per Ton . .	10,500 Cub. Ft.
Illuminating Power . .	16·9 Candles.
Coke (of good quality) . .	67·5 per Cent.
Sulphur	0·58 ,,
Ash	2·73 ,,

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.

QUAYSIDE, NEWCASTLE-ON-TYNE.

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 26 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Full Particulars may be had on application to the Patentee's Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, 5, Stuart Street, Shawlands, Glasgow, Agent for Scotland and Ireland; and to the Principal Agent, **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non*

TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

The Patentee's SELF-SEALING CAPS FOR THE TOP OF ASCENSION-PIPES, and his "SPECIAL" FLUE PORT BOXES, are most important additions to his Carbonizing Plant.

SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S Patents, all Spent Limes are effectively recovered at from one-third to one-half the cost of New Lime.
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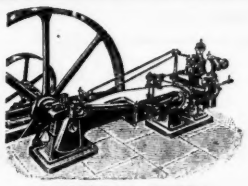

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Analysis: 12,600 feet of 19-candle gas per ton.
Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.
Telegrams: "ATLAS SHEFFIELD."

SELF-SEALING MOUTHPIECES

Made strong for Horizontal and Inclined Retorts in Round, Oval, and ⌂ shapes, and to open at Right Angles for Machine Work. Faced in Ruscoe's Patented Machines; thus ensuring correct and smooth joints when closed.

TESTIMONIALS.

Sheffield United Gaslight Company, Commercial Street, Sheffield, 11th April, 1895.

DEAR SIR,—In reply to your enquiry, I have pleasure in saying that we have a number of your Retort Mouthpieces at work, and that they give perfect satisfaction.

Yours faithfully,
FLETCHER W. STEVENSON,
Engineer.

MR. JOHN RUSCOE.

Leigh Urban District Council, Gas & Water Departments, Leigh, Lancs., April 11th, 1895.

DEAR SIR,—In reply to yours of yesterday, I have pleasure in testifying that the Retort Mouthpieces which you supplied to the Leigh Gas-Works seven years ago have given every satisfaction. We have now 267 of the Mouthpieces erected, and hitherto none have required refacing.

Yours faithfully,
A. T. FLETCHER.

MR. J. RUSCOE, Albion Works, Hyde.

FOR PARTICULARS APPLY TO **JOHN RUSCOE, ALBION WORKS, HYDE.**

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RETORT-SETTING & Gaseous Firing a Speciality.

MAIN LAYING,

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INCLUDING SINKING WELLS AND BOREHOLES.

GASHOLDER TANKS.

Established 20 Years.

CLAYTON SON & Co., LTD., LEEDS

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ALSO THE LARGEST METAL TANK

See Advertisement last week, also next week

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WILLIAM INGHAM & SONS,

Incorporated with the Leeds Fire-Clay Company, Ltd.,

WORTLEY FIRE-CLAY WORKS,

Near LEEDS,

Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—

1. Smooth interior, preventing adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
3. Uniformity in thickness, ensuring equal Expansion and Contraction.

PATENT

MACHINE-MADE GAS-RETORTS.

GAS AND WATER PIPES

AND

CASTINGS OF EVERY DESCRIPTION.

MANUFACTURED BY THE

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IMPROVED

Sulphate of Ammonia Apparatus.

The most successful and approved Apparatus known up to the present time.

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CHANCE BROTHERS, OLDBURY (Four Apparatus).
RUNCORN SOAP & ALKALI CO., Limited, RUNCORN.
NETHAM CHEMICAL CO., Limited, BRISTOL.
ANIMAL CHARCOAL CO., Limited SHADWELL.
WM. BUTLER & CO., BRISTOL.
KEMPSON & CO., Pye Bridge.

And to the following Gas Companies and Corporations—

ILKESTON.	BURY.	CHORLEY.
WIDNES.	BRIGHOUSE.	WHITEHAVEN.
HALIFAX.	MARKET HARBRO'	CHESTER.
ALTRINCHAM.	PRESCOT.	SOUTH SHIELDS
DENTON.	SOWERBY BRIDGE.	LEEK.
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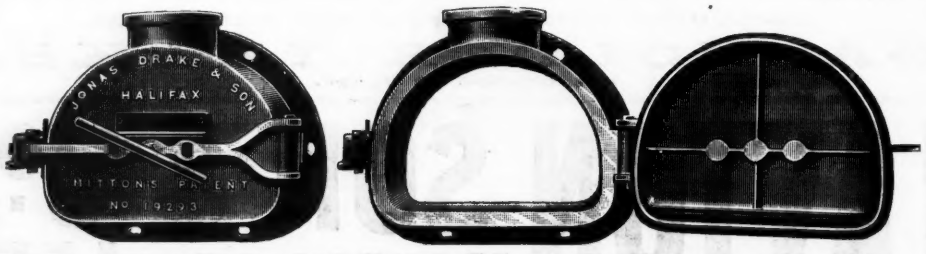
OVENDEN, HALIFAX. — LONDON OFFICE: 60, QUEEN VICTORIA ST., E.C.

Telegraphic Address: "DRAKESON, HALIFAX."



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Sole Agents for "HISLOP'S" Patent Regenerative Furnaces for

ENGLAND, WALES, AND ABROAD.

—SOLE MAKERS OF—

"MITTON'S" PATENT SELF-SEALING RETORT-LID. — "SETTLE'S" PATENT COMBINED SEAL-REGULATING & FLUSH-VALVE.

ALEX. C. HUMPHREYS, M.Inst.C.E. A. G. GLASGOW, M.E.

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Have during the past 2½ years constructed

CARBURETTED WATER-GAS PLANTS

Of the following daily capacities:—

Copenhagen	700,000 Cub. Ft.	Brussels	700,000 Cub. Ft.
Belfast	1,700,000 ,,	Liverpool	2,500,000 ,,
Glasgow	300,000 ,,	Tottenham	600,000 ,,
Santiago	400,000 ,,		

And have now under Contract:—

Belfast (Second Contract)	3,500,000 Cub. Ft.	Southport	750,000 Cub. Ft
Brighton	1,250,000 ,,	Manchester	3,000,000 ,,
Swansea	700,000 ,,	Bath	1,000,000 ,,
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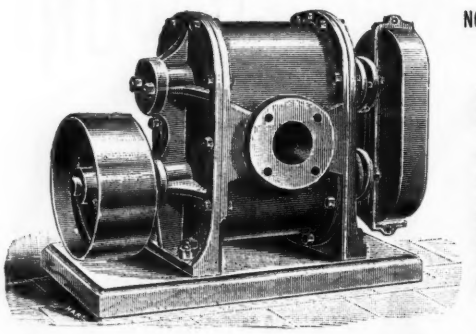
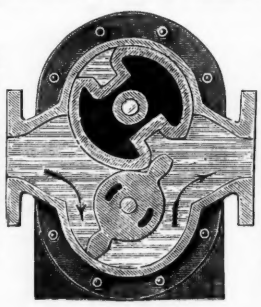

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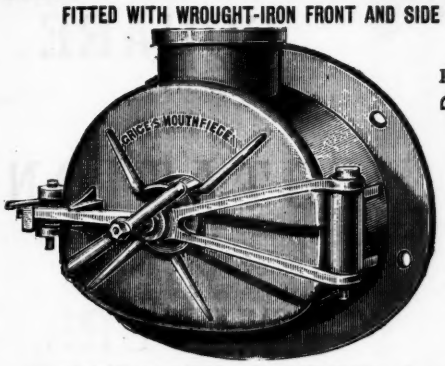

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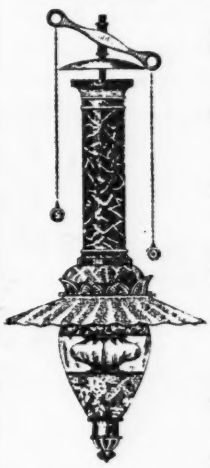

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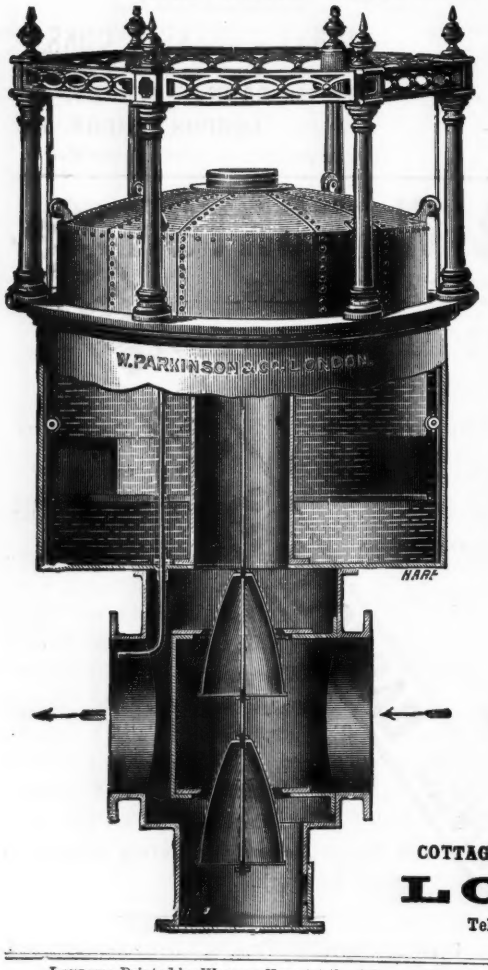

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[See also Advt. p. 122.

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